Studies in Space Policy

Annette Froehlich *Editor*

A Fresh View on the Outer Space Treaty

ESPI
European Space Policy Institute

Springer

Studies in Space Policy

Volume 13

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Springer

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ISSN 1868-5307 ISSN 1868-5315 (electronic)
Studies in Space Policy
ISBN 978-3-319-70433-3 ISBN 978-3-319-70434-0 (eBook)
https://doi.org/10.1007/978-3-319-70434-0

Library of Congress Control Number: 2017960171

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

On the occasion of the 50th anniversary of the Outer Space Treaty, the European Space Policy Institute (ESPI), the Space Generation Advisory Council (SGAC) and the German Aerospace Center (DLR) invited students and young professionals globally to submit a paper which offers a fresh approach on the Outer Space Treaty.

The aim of this competition was to draw up a paper with a new legal view on the Outer Space Treaty. As such, the paper neither aims to discuss the history of the Outer Space Treaty nor to question current or ambiguous legal obligations under the Outer Space Treaty. Rather, it ambitions to provide an actual approach on the Outer Space Treaty, proposing new legal obligations that could be included, solutions to overcome diverging interpretations of current legal obligations or solutions that fill a void in the existing legal regulations of the Outer Space Treaty. Nevertheless, this should not be limited to an interpretation or perspective in the interest of one or a minority of states. Any new legal obligation or solution shall account for the needs and interests of the whole international community and thus should be able to gain the acceptance of said whole international community. Moreover, the point was to focus on one issue at a time, rather than trying to discuss a number of issues, allowing thus to adhere to the word limit while still offering an in-depth study. Beyond this limitation, authors were free to choose their subject, although they were encouraged to choose a unique and novel subject.

This essay competition was set up to give a voice to the next generation in the international space community by providing them fruitful scientific research experience. At a later stage, selected papers will be used as working material to support the discussion of the 16th Space Generation Congress Working Group titled "Outer Space Treaty: The Next Fifty Years".

Special thanks and appreciation goes to Lauren Napier from SGAC for her valuable support as editorial assistant in this project. She kindly supported the project by preparing documents and corresponding with the authors for compilation. Our grateful thanks goes also towards Vincent Seffinga for his support in the preparatory works.

Vienna, Austria
August 2017

Dr. Annette Froehlich
European Space Policy Institute (ESPI)
seconded by German Aerospace Center (DLR)

Executive Summary

The Global Space Law Essay Competition was set up to give students and young professionals globally a possibility to contribute to the ongoing reflections on the Outer Space Treaty (OST). On the occasion of the 50th anniversary, it should not only be to look back to its achievements in the last five decades but also to analyse what should be included in the OST to make this treaty better adapted for upcoming space endeavours.

Generally, the ongoing discussions of the space law community are turning around the legality of space resources mining, space traffic managing or the inclusion of the private sector in space. Instead the invited young persons opted more in favour of topics around environmental protection and how to seize the questions of militarization and the peaceful use of outer space. Others, aware that new social questions may arise, advocate for new perceptions, definitions and governance systems to embrace upcoming aspects of future settlements in space in order to avoid former colonialist mistakes.

Therefore, it is very instructive to have a glance at space topics which should be comprised by the Outer Space Treaty so that space activities and the use of outer space may be ensured for the next decades.

Environmental issues are a topic of high priority, and several aspects were analysed from different angles. At the time of the drafting of the OST, its purpose was to avoid a space race or any kind of military conflict. As environmental issues were not in the focus of the authors of this treaty, effective environmental protection provisions were not formulated and included in the OST. Influenced by newer international aspirations to protect the environment on Earth, it is considered wise to include the achieved common understandings and principles for the benefit of earthly environment protection as well in the Outer Space Treaty. Meanwhile, the Rio Declaration on Environment and Development has generated principles, which may also account for the outer space environment to foster its sustainable development. Therefore, a transfer of the Rio Principles on Environmental Protection in the OST is proposed. Even if this Rio Declaration is not legally binding, its fundamental principles were adopted by consensus. This is particularly the case for the

provisions establishing mutual obligation in respect to information, notification and consultation and the "Precautionary Principle" including a reverse burden of proof. For outer space, this would mean that the operators in space would have to prove that their activities have no harmful effect on the space environment. Since space activities are hazardous and their influence on environment may be uncertain, it is proposed that this absolute reverse burden of proof only comes to effect in case of a "prima facie evidence of risks".[1]

Moreover, in the field of protection of the environment, unresolved aspects around the international responsibility arising from pollution should be analysed furthermore. Even if the current international space regulations do not provide rules for it, new regulations may be inspired by the general principles of international law on states' responsibility for wrongful acts.[2]

Another pivotal question turns around the topic of how to maintain peace in an environment which is highly demanded not only for its resources but also for its strategic positioning for space-based infrastructure. How may the deliberated destruction of a satellite of another state be thus considered in the frame of the international concept of threat to the peace or breach of the peace? In addition, the debris emanating from such an intentional destruction of a satellite may endanger thereupon also the peaceful use of outer space.[3] Moreover, the Outer Space Treaty seems not to be adequately adapted to the ongoing peacekeeping mission of the United Nations as Art. IV OST contains some ambiguities. From one side, the use of military personnel for scientific research or any other peaceful purpose shall not be prohibited (provision which advocates for a possible intervention of UN peacekeepers in outer space), but from another side, establishment of military bases and installations is forbidden by the same Art. IV OST. Therefore it seems that the OST turns UN peacekeeping missions in outer space impossible as those kinds of operations need usually a headquarters support unit in situ. In consequence, a rephrasing of this article should be envisaged to ensure that a UN peacekeeping operation in outer space may be possible in case of threat emanating from futuristic threatening scenarios and actions.[4] As already mentioned, the OST was developed to avoid any military conflicts in space; nevertheless, this aspect keeps remaining. Indeed, the question of how space can remain out of military aspirations is still of utmost importance as most of space operations are or can be perceived and employed in its dual-use capacity. Moreover, the unshielded satellites are considered as soft targets, easy

[1] Rf. Gordon Chung, The Emerging of Environmental Protection Clauses in the Outer Space Treaty: A Lesson from the Rio Principles, p. 1.

[2] Rf. Giulia Pavesi, Legal Consequences of Environmental Pollution in Outer Space, p. 15.

[3] Rf. Alexander Gairiseb, Intentional Destruction of Satellites in Relation to International Peace and Security, p. 31.

[4] Rf. Eduardo Bressel Baratto, Peacekeeping Operations in Outer Space: Contradictions in Article IV of the Outer Space Treaty, p. 39.

to track due to their predictable orbits. In consequence, this exposes them in such a way that critical infrastructure of spacefaring nations may be at risk.[5]

Considering our further stay in space, the OST should also take into account new settlements by humans in space, i.e. on other celestial bodies. In addition, the primary intention of the OST was to avoid the possibility to claim resources as this was considered as a source of conflicts. This would then raise the question of how to start new human settlements without the possibility of a certain national appropriation. To solve this ambiguity, a change in humanity's legal perspective of the universe is suggested which guides also to a change of interpretation of the OST and outer space. The OST itself always stipulates that outer space is "including the Moon and other celestial bodies". This leads to the conclusion that Earth is exospatial and to the fact that the non-appropriation principle does not apply to Earth, but to all outer space (including Moon and other celestial bodies). Therefore it is advocated for a new definition. Accordingly, outer space is "the space outside of a celestial body's gravity well relative to a state's presence and perspective on that particular celestial body". Moreover, the non-appropriation principle should be applicable for any celestial body in the universe outside of the gravity well of the celestial body on which the nation exists. However, in order to avoid a non-appropriation of celestial bodies such as asteroids (in order to exploit their resources), it is proposed that celestial bodies with minimal gravity wells are exempt of this non-appropriation principle. Concerning the moons, it is suggested that a decision should be taken on a political level due to the various types of moons and the fact that they have gravity wells of their own and are situated within the overall gravity well of their parent planets.[6]

Additionally, it is not only interesting to see how the Outer Space Treaty influences the rights and responsibilities of humans and robots in today's law but also how this may influence and provoke changes in international regulations in the future. Reflections are undertaken to consider including an appropriate section of robotic law in the OST in order to take into account the fact that some nations consider giving "personhood" status to robots. Nevertheless, a change of the OST in this perspective should also reflect the different level of digital development of its state parties.[7]

Finally, it is also expected from the OST to balance the ambitions of the private sector and the sovereignty of nations. Therefore, the OST should include principles of governance. Different (classic and emerging) models of institutionalized space governance may be feasible. However, following classic models, the legitimacy derives from elections. Nevertheless, in most specialized space institutions, experts

[5] Rf. Matteo Frigoli, Wild Military Operations in Space: A Sword of Damocles Hanging over Future of Space Environment and Space Activities, p. 49.

[6] Rf. Zach Miller, Space Settlement and the Celestial Subjectivity Model: Shifting Our Legal Perspective of the Universe, p. 59.

[7] Rf. Maria Baczyńska-Wilkowska, Outer Space Treaty During Fourth Industrial Revolution, p. 67.

are appointed. Moreover, the OST should foresee the possibility to install a specialized supranational judicial body equipped with a sufficient flexible method allowing to create standards to accommodate the evolutions of space technologies and activities. In this regard, not only states but also private actors in space should be entitled to appeal to this court. Furthermore, the model "law without states" is analysed as a possible concept for space governance considering that more and more private initiatives are carried out in space and that states are no longer the only actors in space.[8]

[8] Rf. Valentin Degrange, Into the Twenty-First Century: Integration of Principles of Global Governance in Space Law, p. 75.

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Chapter 1
Emergence of Environmental Protection Clauses in Outer Space Treaty: A Lesson from the Rio Principles

Gordon Chung

Abstract Today, the virtually unrestricted exploration and use of outer space gives birth to the increasingly severe problem of extra-terrestrial pollution that merits special attention. Under the present Outer Space Treaty (OST) regime, while Article IX calls for the avoidance of harmful contamination in space and the need for international consultations, it is ineffective as an environmental protection provision, primarily due to the absence of more rigorous environmental standards governing space activities and the inherent uncertainties associated with its applicability. Notably, for reformatory purpose, the 1992 Rio Declaration on Environment and Development has significant referential value for formulating environmental regulations in space law as it embodies various fundamental principles of environmental law and represents the first international document of 'constitutional dimension' to read those environmental principles through the lens of sustainable development. Accordingly, to facilitate the sustainable, progressive development of the outer space, this article proposes that the existing OST regime should be reformed along two major lines: (1) the incorporation of the 'environmental consultation' clauses under Principles 18 and 19 of the Rio Declaration into the Treaty and (2) the application of the precautionary principle enshrined in Principle 15 of the Rio Declaration to the outer space context.

1.1 Introduction

Generally speaking, pollution refers to 'a modification on the environment through human agency by the introduction on undesirable elements or by the undesirable use of elements'.[1] Today, extra-terrestrial pollution deserves particular attention and

[1] I.H.Ph. Diederiks-Verschoor, 'Environmental Protection in Outer Space' (1987) 30 German Y.B. Int'l L. 144, 144.

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A. Froehlich (ed.), *A Fresh View on the Outer Space Treaty*, Studies in Space Policy 13, https://doi.org/10.1007/978-3-319-70434-0_1

is increasingly attributable to a variety of sources, including space debris, chemical effluents, biological contamination and radioactive waste.[2] The reason why the outer space environment merits special protection is that it constitutes an indirect part of the human ecological sphere, dubbed as a 'para-environment'.[3] In fact, outer space is an extremely fragile environment that does not allow any mistakes to be made.[4] And, what is more important, the unrestricted spoilage of this pristine environment will inevitably hinder the future exploration and use of, and endanger free access to, outer space at the complete expense of the interests of all non-space-faring nations.[5] The environmental issues in outer space, therefore, deserve closer examination, particularly in view of the immature development of environment-friendly space technology and practice in the modern space sector.[6]

Throughout the current Outer Space Treaty (OST) regime, Article IX represents the most fundamental – if not the only – provision in space law for protection of the outer space environment and its preservation for peaceful uses.[7] It imposes a duty on States to exercise 'due regard' for the interests of other countries when conducting any space activity[8] – known as the 'due regard' principle.[9] More specifically, this provision attempts to tackle the environmental issues in space, by creating a 'proscriptive positive legal obligation'[10] for all States to (1) *avoid* harmful contamination of celestial bodies and (2) undertake international consultations in advance before any potentially harmful interference may arise from their activities.[11] However, in light of the impotence and inherent vagueness of Article IX as well as the inevitable need for harmonisation of international environmental law and space law, this analysis argues for the incorporation of the 'environmental consultation' clauses and the precautionary principle into the existing OST regime with reference to the 1992 Rio Declaration on Environment and Development (Rio Declaration) and with a view to fostering the sustainable development of space activities.

[2] Stephen Gorove, 'Pollution and Outer Space: A Legal Analysis and Appraisal' (1972) 5 New York Journal of International Law and Policy, 55.

[3] Saara Reiman, 'Is Space an Environment?' (2009) Space Policy 25, 81–87.

[4] Paul B Larsen, 'Application of the Precautionary Principle to the Moon' (2006) 71 J. Air L. & Com. 295, 298.

[5] Lotta Viikari, *The Environmental Element in Space Law: Assessing the Present and Charting the Future* (Brill/Nijhoff 2008) 147.

[6] Ibid. 147.

[7] Sergio Marchisio, 'Article IX' in Stephan Hobe and others (eds.), I *Cologne Commentary On Space Law* (Carl Heymanns 2009) 176.

[8] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies 1967, art IX.

[9] Michael C Mineiro, 'FY-1C and USA-193 ASAT intercepts: An Assessment of Legal Obligations Under Article IX of the Outer Space Treaty' (2008) 34 J. Space L. 321, 333.

[10] Ibid. 332–333.

[11] OST, art IX.

1.2 Current OST Regime: Continued Absence of Effective Environmental Protection Provisions

Notably, a close reading of the principles enshrined in Article IX reveals that they gear towards the protection of human beings rather than the attainment of environmental protection as an end in itself.[12] In fact, space law scholars have long regarded Article IX as an impotent provision because it fails to set standards in the field of the space environment or, at a minimum, entrusts a regulatory body to do so.[13] Furthermore, commentators have been very consistent in their view that Article IX, as far as its legal nature is concerned, has not evolved into customary law.[14] Hence, to what extent can this flawed provision effectively address the increasing environmental concerns in outer space?

1.2.1 'Harmful Contamination' Clause: Limited Coverage

As a starting point, Article IX of the OST explicitly provides that States must avoid 'harmful contamination' to the outer space environment.[15] That being said, since the 'harmful contamination' clause aims not to safeguard the space environment per se but primarily to further scientific utility, the threshold for pollution should be set relatively high.[16] In particular, the narrow applicability of this clause is evident from its express confinement to the 'studies' and 'exploration' of space.[17] This terminological emphasis implies that exploitative activities in outer space go beyond the reach of the 'harmful contamination' clause, especially in light of the intentional omission of the word 'use'.[18] Even if the 'use' of outer space indeed falls within the restriction stipulated in Article IX, the term 'avoid' delineates that the obligation is not one of absolute prevention of harm but is one of discretionary nature.[19]

Moreover, the expression 'harmful contamination' does not provide an all-inclusive definition encompassing all forms of harm. In space law literature, 'harmful contamination' is variously defined as the 'introduction of elements that make

[12] Philippe Sands and others, *Principles of International Environmental Law* (3rd edn., Cambridge University Press 2012) 300.

[13] Ruwantissa IR Abeyratne, *Frontiers of Aerospace Law* (Routledge 2002).

[14] See Lawrence D Roberts, 'Addressing the Problem of Orbital Space Debris: Combining International Regulatory and Liability Regimes' (1992) 15 B.C. Int'l & Comp. L.Rev. 51, 61; Bin Cheng, *Studies in International Space Law* (Clarendon Press 1997).

[15] OST, art XI.

[16] George T Hacket, *Space Debris and the Corpus Iuris Spatialis* (Gif-sur-Yvette 1992) 104.

[17] Delbert D Smith, 'The Technical, Legal and Business Risks of Orbital Debris' (1997) 6 N.Y.U. Envt'l. L.J. 50, 56.

[18] Ibid.; Maureen Williams, 'Dispute Resolution Regarding Space Activities' in Frans von der Dunk (ed), *Handbook of Space Law* (Edward Elgar 2015) 1001.

[19] Mineiro (n 9) 340.

outer space unfit for use',[20] or as the 'intentional introduction of strange items and substance into outer space'.[21] Yet, despite its apparently broad formulation, the clause focuses primarily on the release of harmful microbiological organisms of terrestrial origin from any accidental collision or explosion in outer space, and it is questionable whether or not the definition extends to include all other sources of environmental harm such as orbital debris (which should preferably be described as 'space object').[22] In any event, States are granted a wide discretion to determine what measure constitutes 'appropriate'[23] to avoid harmful contamination, and this part of Article IX is certainly devoid of practical significance.[24]

1.2.2 'International Consultation' Clause: Vague Threshold of Harm

Further, Article IX requires a State to undertake 'international consultations' before proceeding with any space activity that it has 'reason to believe' would cause 'potentially harmful interference'.[25] This procedural requirement, as a specification of 'appropriate measures' envisaged in Article IX, was in fact outgrown from the 'due regard' principle and the 'harmful contamination' clause.[26] However, without an express mention of the protection of the extra-terrestrial environment, the 'international consultation' clause seems to place exclusive emphasis on the 'mutual respect for national interests'.[27] Therefore, the consultation clause is not construed as protecting the outer space environment per se but rather as safeguarding the space activities of all States.[28]

First and foremost, an essential criterion of the applicability of the consultation clause is the occurrence of 'potentially harmful interference'.[29] It is noteworthy that the expression 'harmful interference' is interpreted to cover three main types of harm: (1) observational interference, (2) radio-frequency interference and (3) physical interference.[30] Accordingly, it seems that adverse environmental effects do not strictly fall within the intended meaning of 'harmful interference' unless they are

[20] Ibid. 339.

[21] YM Kolossov, 'Legal Aspects of Outer Space Environmental Protection' (1980) 23 I.I.S.L. PROC. 103, 103.

[22] Howard A Baker, *Debris and Policy Implications* (Martinus Nijhoff Publishers 1989) 103.

[23] OST, art IX.

[24] Mineiro (n 9) 340.

[25] OST, art IX.

[26] Jerzy Sztucki, 'International Consultations and Space Treaties' (1974) 17 Colloquium L Outer Space 147, 157.

[27] Hacket (n 16) 122.

[28] Lotta Viikari, 'Environmental Aspects of Space Activities' in (n 18) 730.

[29] Sztucki (n 26) 157; Mineiro (n 9).

[30] Mineiro (n 9) 337.

capable of restricting the physical movement or interfering with the physical operations in outer space – thus possibly amounting to 'physical interference'. Yet, even if this is the case, it then prompts the question of whether, as long as the space activities of another State are interfered by the environmental effects inflicted by a State, however trivial they seem to be, the duty to consult under Article IX is triggered. Where and how can we draw the line? It appears that the language of 'potentially harmful interference' does an ineffective job in indicating a proper threshold of harm.

The second question concerns the difficulty of establishing the relevant 'harm' threshold under the OST, which gives no further guidance on this issue.[31] Commentators have been quite consistent in their view that a predominantly subjective test is implied in Article IX for deciding whether or not a 'reason to believe' exists.[32] The terminology of the consultation clause, on its face, allows States to retain a 'wide degree of latitude' in determining whether or not the implementation of consultative engagement is due.[33] More importantly, such consultations are devoid of practical value unless an Environmental Impact Assessment (EIA) – which is not a well-established tool in the international law of outer space – is carried out. Therefore, in reality, the 'international consultation' clause rarely acts as a procedural bar to any environmentally harmful activity in outer space. Even though the potentially affected States have the right to request appropriate consultation,[34] there is no compulsory obligation to act upon their recommendations.[35]

1.3 Transplantation of *Rio* Principles on Environmental Protection: Sustainable Development of Outer Space

Based on the foregoing analysis, it is reasonable to say that the existing OST regime fails to offer a comprehensive legal framework that safeguards the outer space environment and to establish more rigorous environmental standards governing the conduct of space activities.[36] Given that space activities evolve with their 'characteristic rapidity', there is a pressing need for employing international law to address their ongoing environmental issues.[37] This is especially so when one considers the fact that international law has placed undue emphasis on the fundamentality of

[31] Viikari (n 5) 176.

[32] Sztucki (n 26) 164; Hacket (n 16) 124.

[33] Ibid.; Mineiro (n 9) 338.

[34] OST, art IX.

[35] I.H.Ph. Diederiks-Verschoor and Vladimír Kopal, *An Introduction To Space Law* (3rd ed., Kluwer Law International 2008) 125.

[36] Shawkat Alam and others (eds.), *Routledge Handbook of International Environmental Law* (Routledge 2013) 390.

[37] See Abeyratne (n 13).

environmental protection.[38] For reformatory purpose, the principles of the 1992 Rio Declaration, standing as a radical and inspirational pronouncement from 172 States, deserve particular attention. Although the Rio Declaration is not legally binding or a constitutional instrument in its strict sense, it should be seen as possessing a *constitutional dimension* since it is the only international instrument adopted by consensus that conciliates the most fundamental principles of international environmental law with socio-economic development.[39] Today, a number of international treaties[40] and States[41] consistently endorse and refer to the basic principles enshrined in the Rio Declaration. Accordingly, incorporating some of these principles into the present OST regime can more likely foster the progressive development of environmental law in outer space.[42]

1.3.1 Procedural Safeguard: Implementation of 'Environmental Consultation' Clauses

The mutual obligations of States concerning information and notification in Principles 18 and 19 of the Rio Declaration, unlike the 'international consultation' clause under Article IX, are procedural elements of sustainable development recognised in customary international law.[43] It follows that any violation of these two principles will constitute international wrongful acts and thereby result in the cessation of environmentally destructive activities.[44] Notably, these two principles can serve as the 'model' provisions for space law scholars to construe more effective 'environmental consultation' clauses in compensation for the inherent ambiguities associated with the existing consultation clause in the OST.

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[38] Owen McIntyre and Thomas Mosedale, 'The Precautionary Principle as a Norm of Customary International Law' (1997) 9 J. Envtl. L. 221, 221.

[39] Jorge E Viñuales, 'Preliminary Study' in Jorge E Viñuales (ed.), *The Rio Declaration On Environment And Development: A Commentary* (Oxford University Press 2015) 1, 60 (emphasis added).

[40] See Viikari (n 5) 128; Convention on the Law of the Non-Navigational Uses of International Watercourses 1997 (U.N. Watercourses Convention), Preamble.

[41] Sumudu Atapattu, 'International Environmental Law and Soft Law: A New Direction or A Contradiction?' in Cecilia M. Bailliet (ed), *Non-State Actors, Soft Law and Protective Regimes: From the Margins* (Cambridge University Press 2012) 209.

[42] Viikari (n 5) 128.

[43] Peter Malanczuk, *Akehurst's Modern Introduction to International Law* (Taylor & Francis 2002) 251; L Boisson De Chazournes and K Sangbana, 'Principle 19' in (n 39) 502; Phoebe Okowa, 'Principle 18' in (n 39) 479–80; Philippe Sands, *Principles of International Environmental Law* (Manchester University Press 1995) 606–607.

[44] *Rainbow Warrior* (*New Zealand v France*) (1990) 82 ILR 499, 573, para 114.

1.3.1.1 Prior Notification and Consultation

To begin with, Principle 19 of the Rio Declaration, in essence, serves as a preliminary procedural hurdle, by mandating that States must give 'prior and timely notification and relevant information' to potentially affected States on activities that may have a 'significant adverse transboundary environmental effect' and must 'consult with those States at an early stage in good faith'.[45] The necessity of notification and consultation, particularly in the context of protecting a pristine environment with shared natural resources, is early reflected in the *Corfu Channel* case,[46] widely recognised by the international tribunal,[47] and well established in a range of international instruments.[48] Notably, the 'harm test' under international environmental law is less subjective than, and differs substantially from, the 'test for reasonable belief' under Article IX. The triggering condition for Principle 19, if applied directly to the extra-terrestrial context, is establishing the existence of outer space activities that have a *significant adverse transboundary environmental effect*.[49] This condition first begs the question of whether *transboundary* harm, which seemingly presupposes an assertion of territorial claim in breach of the non-appropriation principle, can actually exist in outer space. In fact, the International Law Commission (ILC) has adopted such a flexible interpretation of the term 'transboundary' that it is not limited exclusively to the 'territory' of a State but extends to cover any places over which a State exercises 'jurisdiction' or 'control'.[50] As a State can, by virtue of Article VIII of the OST, be legitimately granted the 'jurisdiction and control' over its space object(s) and facilities for an indeterminate period of time,[51] the ILC definition of 'transboundary' appears to accommodate the impossibility of delimiting any space territory among nations and is thus applicable to the outer space.

As far as the extent of harm is concerned, although international law does not strictly define the 'gravity threshold' that requires notification to take place,[52] the alleged 'transboundary environmental effect' must reach a certain level of gravity.[53] According to the ILC, the word 'significant' is interpreted to mean 'something more

[45] Rio Declaration, Principle 19.

[46] *Corfu Channel* (*UK v Albania*) (Judgment) [1949] ICJ Rep 4. See also ILC Prevention articles with Commentaries, [2001] 2 Y.B. Int'l L. Comm'n 148, U.N. Doc. A/C.N.4/SER.A/2001/Add.1 (Part 2), art 8, 159, para 3.

[47] See *Land Reclamation by in and around the Straits of Johor (Malaysia v Singapore)* (Provisional Measures) [2003] ITLOS Reports, 10, para 106; *MOX Plant (Ireland v UK)* (Provisional Measures) [2001] ITLOS Reports, 95, para 89.

[48] Convention for the Protection of the Marine Environment of the North-East Atlantic 1993, art 21(1); Convention on Long-Range Transboundary Air Pollution 1979, art 5.

[49] RD *Munro* and JG *Lammers*, *Environmental Protection and Sustainable Development: Legal Principles and Recommendations* (Springer 1987) 104–105.

[50] ILC Prevention articles with Commentaries (n 46), art 2(c).

[51] OST, art VIII.

[52] Chazournes and Sangbana (n 43) 496.

[53] Ibid.

than "detectable" but which need not rise to the level of "serious" or "substantial"'.[54] Notably, this ILC definition mirrors what commentators call the '*de minimis* test' under which as long as the environmental effect is not minor (either insignificant or trivial), the threshold is crossed.[55] More importantly, the question of what environmental impact is considered 'significant', while essentially determined by factual and objective criteria, also denotes a value judgement that is dependent upon the circumstances of each particular case.[56] Hence, the ILC approach seemingly displays a dual subjective-objective standard that sounds more pragmatic and practicable,[57] when compared with the predominantly subjective test for reasonable belief under Article IX. Moreover, the language of 'significant' has been generally accepted in international environmental agreements, and this qualification is considered capable of achieving a proper balance.[58] At the end of the day, as a matter of policy, the adjudicator is also required to carry out a balancing exercise between the 'socio-economic utility' of the space activity and its 'detrimental effects' on the pristine space environment, thus being compatible with the principles of equity and fairness firmly rooted in international law.[59]

Further, it is worth noting that Principle 19 constitutes a specific obligation of performance (*obligation de faire*) demanding a State to give 'prior and timely notification' to the potentially affected States before carrying out its activities.[60] More specifically, the ILC defined the term 'timely' as 'intended to require notification *sufficiently early in the planning stages to permit meaningful consultations and negotiations*'.[61] Hence, the ultimate purpose of consultations is for the potentially affected States who object to the proposed (environmentally destructive) activities to seek the most ideal solutions regarding measures to be taken to eliminate the risk.[62]

[54] ILC Prevention articles with Commentaries (n 46) art 2, 152, para 4 (emphasis added).

[55] R Lefeber, *Transboundary Environmental Interference and the Origin of State Liability* (Kluwer Law International 1996) 24.

[56] John G Lammers, 'Prevention of Transboundary Harm From Hazardous Activities The ILC Draft Articles' in AC Kiss and Johan G Lammers (eds.), *Hague Yearbook of International Law* (Martinus Nijhoff Publishers 2002) 7.

[57] Kevin R Gray, Cinnamon Piñon Carlarne and Richard Tarasofsky, *The Oxford Handbook of International Climate Change Law* (Oxford University Press 2016) 473.

[58] Lammers (n 56) 7.

[59] Gray, Carlarne and Tarasofsky (n 57) 473.

[60] Chazournes and Sangbana (n 43) 502.

[61] Draft Articles on the Law of the Non-Navigational Uses of International Watercourses and Commentaries [1994] 2 Y.B. Int'L. Comm'n 89, U.N. Doc. A/CN.4/L.493 (Part 2), art 12, para 4.

[62] Chazournes and Sangbana (n 43) 500.

1.3.1.2 Post-disaster Notification

In complementary to Principle 19 of the Rio Declaration, Principle 18 further imposes a mandatory obligation to 'immediately notify other States of any natural disasters or other emergencies that are likely to produce sudden harmful effects on their environment'.[63] This obligation of notification of emergencies, as reflected in a number of international instruments,[64] aims at offering the potentially affected States an opportunity to react promptly in order to prevent or mitigate any environmental damage.[65]

As a starting point, Principle 18 is most saliently distinguished from Principle 19 by the nature of its triggering event. The existence of 'natural disasters' or 'emergencies' triggers the duty to notify under Principle 18.[66] Notably, the Draft Articles on the Protection of Persons in the Event of Natural Disasters[67] adopted by the ILC in 2016 define the term 'disaster' as 'a calamitous event' resulting in 'widespread loss of life, great human suffering and distress … or large-scale material or environmental damage, thereby seriously disrupting the functioning of society',[68] whereas the word 'emergencies' is interpreted to mean the circumstances 'that cause, or pose an imminent threat of causing, serious harm'.[69] Nowadays, Principle 18 is even extended to man-made disasters,[70] and it apparently entails a higher gravity threshold.[71] Having said that, it is suggested that so long as the activity in question is *intrinsically hazardous* or if it is located in *close proximity to an area of significant ecological importance*, there exists a presumption of gravity.[72] If this view is accepted, outer space activities which are in general considered *par excellence* ultrahazardous[73] should be presumed to present an element of gravity and thus warrant notification. Applying the above analysis to hazardous space activities would clearly render the notification requirement an essential part of the OST regime in furtherance of international cooperation and the sustainable development of the outer space.

Second, unlike the notification required in Principle 19, the one in Principle 18 can actually take place *after* the conduct of the activities and thus serve as a second line of procedural bar to environmentally destructive activities. While Principle 18

[63] Rio Declaration, Principle 18.

[64] See Revised Protocol on Shared Watercourses in the Southern African Development Community 2000, art 4(5); U.N. Watercourses Convention, art 28.

[65] Christina Leb, *Cooperation in the Law of Transboundary Water Resources* (Cambridge University Press 2013) 126.

[66] Okowa (n 43) 474.

[67] Draft Articles on the Protection of Persons in the Event of Natural Disasters 2016, art 3(a).

[68] Ibid.

[69] U.N. Watercourses Convention, art 28(1).

[70] Rio Declaration, Principle 18.

[71] Okowa (n 43) 475.

[72] Ibid.

[73] Diederiks-Verschoor (n 35) 14.

deploys a 'narrowly circumscribed time element' in explaining its operative scope – to notify other States of disasters that *have just occurred* – a close examination of the subsequent practice of States unveils that the actual duty extends to the adoption of preventive and mitigation strategies in the first place with a view to counteracting the environmental effects.[74] More importantly, the terminology of Principle 18 suggests that the duty to notify extends to all States that become aware of, or possess the relevant information on the likelihood of, an impending disaster.[75] That being said, the responsible State is obliged to respond to specific requests for information from all other States.[76] Failure to do so will lay the basis for questioning the *bona fides* of that State or the accuracy of its assessment of the gravity of the situation,[77] thereby in potential breach of Principle 18.

In short, one should note that clauses akin to Principles 18 and 19 of the Rio Declaration should be incorporated into the OST regime as they constitute a more environmentally centred set of provisions that entails a saliently different, but more balanced, gravity threshold for notification and consultation. These formulations can certainly provide better procedural safeguards to both space-faring and non-space-faring nations for the environmentally sustainable development of space activities.

1.3.2 Incorporation of 'Precautionary Principle' into OST Regime

While the Rio Declaration embodies various procedural requirements of environmental law, the precautionary principle, firmly enshrined in many international treaties[78] and cases,[79] serves as the most vital tool to be utilised for the attainment of sustainable development of outer space. Specifically, Principle 15 of the Rio Declaration[80] highlights the emblematic character of the precautionary principle and has elevated it into customary international law,[81] the breach of which will result in the cessation of activities.[82] Simply put, this principle strives to avoid the occurrence of 'serious or irreversible'[83] environmental damage, by demanding States to take precautionary steps in

[74] Okowa (n 43) 478.

[75] Ibid. 476.

[76] Ibid. 477.

[77] Ibid.

[78] See Stockholm Declaration on the United Nations Conference on the Human Environment 1973, Principle 21; U.N. Framework Convention on Climate Change 1992, art 3(3).

[79] *Pulp Mills (Argentina v Uruguay)* (Judgment) [2010] ICJ Rep 14, para 205.

[80] Rio Declaration, Principle 15.

[81] Sands (n 43) 211–213; McIntyre and Mosedale (n 38) 224.

[82] *Rainbow Warrior* (n 44).

[83] Rio Declaration, Principle 15.

carrying out any activity or scientific experiment.[84] More notably, the precautionary principle encompasses the situation where 'scientific evidence is not conclusive'[85] or where 'potential adverse effects [of an activity] are not fully understood'[86] and thus finds it applicable to the outer space environment that is wrought with uncertainty. Although the 'harmful contamination' clause under Article IX kind of exemplifies the precautionary principle, its coverage is far from sufficient to allow extensive protection of environment. It follows that, as a general rule, a precautionary approach should be widely applied by all States, those space-faring nations in particular, to safeguard the pristine space environment, especially in view of its ultra-fragile nature. For this reformatory exercise, two points merit special emphasis.

First, an emerging modern view of the precautionary principle is that it should be utilised to impose a reverse burden of proof in order to surpass the evidentiary difficulty inherent in proving the presence of environmentally harmful activities in outer space. Following this progressive approach, a State interested in undertaking any space activity bears the onus of proving that such activities will not produce the adverse environmental consequences complained of.[87] Its underlying rationale is that the author of the alleged environmental damage is invariably placed in the best position to produce all the relevant information on its ongoing activities.[88] Yet, despite its apparent soundness, this tame version of precautionary principle has been criticised for being overly costly in the short run, and,[89] more importantly, it ignores the practical impossibility of showing that something is completely safe in an environment of inherent uncertainty.[90] Accordingly, instead of imposing an *absolute* reverse burden of proof, this approach should only operate when a 'prima facie evidence of risks' has been established – a relatively low, yet acceptable, threshold.[91] This is particularly appropriate in relation to the space sector in which there are practical difficulties and particular hardships for a State in proving the harmfulness of the space activities of another State or in obtaining the necessary information

[84] Arie Trouwborst, *Evolution and Status of the Precautionary Principle in International Law* (Kluwer Law International 2002) 15.

[85] Sonia Boutillon, 'The Precautionary Principle: Development of an International Standard' (2002) 23 Mich. J. Int'l. L 429, 432.

[86] U.N. General Assembly Resolution on the World Charter for Nature 1982, para 11(b).

[87] See Viikari (n 5) 176; *Nuclear Tests (New Zealand v France)* (Order) [1995] ICJ 288, 348 (*per* Judge Weeramantry); *Southern Bluefin Tuna (New Zealand v Japan; Australia v Japan)* (Order) [1999] ITLOS Reports, para 14 (*per* Judge Laing); *MOX Plant* (n 47) (*per* Judge Wolfum).

[88] Ibid. 175.

[89] Maurice Sunkin, *Sourcebook on Environmental Law* (2nd edn., Cavendish Publishing 2002) 50.

[90] Annecoos Wiersema, 'The Precautionary Principle in Environmental Governance' in Douglas Fisher (ed.), *Research Handbook on Fundamental Concepts of Environmental Law* (Edward Elgar Pub 2016) 459.

[91] André Nollkaemper, '"What you risk reveals what you value", and Other Dilemmas Encountered in the Legal Assaults on Risks' in David Freestone and Ellen Hey (eds.), *The Precautionary Principle and International Law: The Challenge of Implementation* (Kluwer Law International 1996) 86.

exclusively controlled by the latter.[92] In reality, the discretionary nature[93] of Article XI of the OST also renders information sharing more difficult, and hence shifting the burden of proof in cases of prima facie evidence of risks is necessary to contribute to the objective of precaution in the outer space context.[94]

Second, one should note that a striking feature of the precautionary principle is the undertaking of a comprehensive EIA.[95] Notably, the duty to undertake an EIA was described in the *Pulp Mills* case as '[a] requirement under general international law … where there is a risk that the proposed … activity may have a significant adverse impact in a transboundary context, in particular, on a shared resources'.[96] It follows that States are generally obligated to prepare an EIA in order to identify and assess the potential impacts of their proposed space activities that are of ultrahazardous nature. Most importantly, the development of environmental assessment systems should not be absurdly conceived as an onerous barrier to the progressive or commercial use of outer space. Instead, such systems can substantially minimise long-term costs, by dispensing with the need for deploying expensive pollution abatement technology or paying potentially substantive compensation for damage.[97] On balance, incorporating the precautionary principle into the present OST regime can better ensure the sustainable future development of space activities.

1.4 Conclusion

While extra-terrestrial pollution is an inevitable outcome of the progressive use of the outer space, its escalating severity deserves special attention. Yet, the unpalatable truth is that throughout the existing OST regime, Article IX is the sole provision that partially addresses the deep-rooted environmental concern for outer space, by imposing twin obligations on States, namely, the 'harmful contamination' clause and the 'international consultation' clause. In fact, Article IX was never intended to be an environmentally centred provision, and, most importantly, it fails to set more rigorous environmental standards to effectively govern the ever-increasing (environmentally harmful) space activities. Therefore, in light of the ultrahazardous nature of space activities and the fragile extra-terrestrial environment, the present OST regime must be supplemented by international environmental law. It is

[92] Viikari (n 5) 176.

[93] JF Mayence and Thomas Reuter, 'Article XI' in (n 7) 189, 197; Cheng (n 14) 403–404.

[94] André Nollkaemper (n 91) 86.

[95] Ellen Hey, 'The Precautionary Concept in Environmental Policy and Law: Institutionalizing Caution' (1992) 4 Gielr 303, 311; Boutillon (n 85) 448. See also Rio Declaration, Principle 17.

[96] *Pulp Mills* (n 79), para 204.

[97] Lotta Viikari, 'Environmental Impact Assessment in the Space Sector' in CJ Bastmeijer, Timo Koivurova (eds.), *Theory and Practice of Transboundary Environmental Impact Assessment* (Brill/Nijhoff 2007) 285; D Owen Harrop and J Ashley Nixon, *Environment Assessment in Practice* (Routledge 1999) 9.

noteworthy that the 1992 Rio Declaration, having what commentators call a 'constitutional dimension', is highly essential to this reformatory exercise.

Specifically, Principles 18 and 19 of the Rio Declaration require a State to notify and consult other States both before and after carrying out any environmentally harmful activities. Such 'environmental consultation' clauses should be deployed in the field of space environment as they can establish more reliable gravity threshold that is able to achieve proper balance in compensation for the vagueness inherent in the 'international consultation' clause under Article IX. Second, and more importantly, the precautionary principle enshrined in Principles 15 of the Rio Declaration, while being partially exemplified by the 'harmful contamination' clause under Article IX, should be more fully incorporated into the present OST regime. Particularly in the outer space context, due to the practical difficulty in obtaining information about the ongoing space activities of another State, there should be a reverse burden of proof when a prima facie evidence of risks is established. Further, under the precautionary principle, States are generally obliged to conduct a comprehensive EIA to avert harm to the pristine space environment. In the long run, the establishment of environmental assessment systems can not only contribute to the protection of the space environment but also significantly minimise the costs of space activities arising out of extra-terrestrial pollution. Accordingly, the existing OST should be reformed along the lines of the Rio Declaration to facilitate the sustainable development of outer space.

Chapter 2
Legal Consequences of Environmental Pollution in Outer Space

Giulia Pavesi

Abstract If there was full acceptance of the school of thought which recognises as international customary law the obligation to prevent outer space from harmful contamination and to pursue activities in outer space with due diligence, as crystallised by Articles I and IX of the Outer Space Treaty, then it will become necessary to investigate what will be the consequences of a breach of such an international customary rule of law.

The present discussion will move in this investigation, considering mainly the international responsibility arising from pollution per se, regardless of whether the damage occurred or not, particularly focusing on Article VI of the 1967 Outer Space Treaty.

Since international space law does not provide any secondary rule which specifically regulate the legal consequences of environmental pollution of outer space as such, these provisions will be inferred from the general principles of international law on States responsibility for wrongful acts.

As a matter of fact, if no international responsibility regime is predicted against space pollution per se, the outer space environment would be left completely undefended, opening the road for a totally irresponsible exploitation. In this sense, the international responsibility might be considered as a deterrent against such an attitude, indirectly leading space exploration and exploitation towards prevention and sustainability for the future generations.

In other words, paraphrasing Judge Max Huber's observations in the Spanish Zone of Morocco Claims case, international responsibility for the wrongful act of space pollution should be the necessary corollary of the right of free use and access to outer space on an equitable basis.

Finally, such a responsibility should result in the duty to make reparation for the negative ecological consequences of space pollution.

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A. Froehlich (ed.), *A Fresh View on the Outer Space Treaty*, Studies in Space Policy 13, https://doi.org/10.1007/978-3-319-70434-0_2

2.1 Outer Space Pollution Under International Responsibility Regime for Wrongful Acts

In order to achieve a more effective protection of the outer space environment both for the present and the future generations, in future the importance of the width of Article VI of the Outer Space Treaty,[1] specifically suggesting the applicability of the international responsibility regime for wrongful acts towards space exploration and use, should be stressed. The reason behind the use of this legal framework is that its provisions could potentially play an invaluable role both in the prevention of the illegal activity of contamination, in space and on celestial bodies and in the removal of the negative ecological consequences of space refuse.

In this regard, when secondary norms have to be searched for, the norms on State responsibility for wrongful acts become the *only* ones applicable to the protection of the outer space environment per se.[2] That being said, this regime would also be suggested by the last sentence of Principle XIV of the 1986 Declaration of Principles Relating to Remote Sensing of the Earth from Space, stating that the application of strict liability to remote sensing is « […] without prejudice to the applicability of the norms of international law […]»[3] and is clearly consistent with Article III of the Outer Space Treaty provisions.

As a general rule, international responsibility arises when a wrongful act occurs.[4]

In this view, the notion of responsibility refers to the new secondary relationship arising between the injured State and the responsible one, as a consequence of the breach of the international obligation. This relationship has a complex content, since it does not refer exclusively to the reparation of such a breach, but also includes

[1] Treaty on Principles Governing the Activities of States in Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies of 1967, namely the Outer Space Treaty.

[2] As a matter of fact, as authoritative doctrine underlined, referring to Chap. 4 of the 1998 Report of the International Law Commission: «The ambit of the Draft Articles (on the International Liability Arising from Acts Not Prohibited by International Law) […] although centring on questions of prevention, has been restricted to the "Prevention of Transboundary Damage from Hazardous Activities" and clearly refer to harm done to another State, not to damage or harm caused outwith all territorial jurisdictions to the environment qua environment».

And in more recent times, Marchisio echoed: «[…] If we look at the current situation of general international law, we can see *that absolute/strict liability for harmful consequences of internationally lawful activities is not reflected yet by specific customary norms*. It is well known that the Draft Articles on prevention of the transboundary harm from hazardous activities adopted by the ILC in 2001 confirms such a conclusion». See: F. LYALL, *Protection of the Space Environment and Law*, in *39th Colloquium L. Outer Space*, 1996, 476. S. MARCHISIO, P*rotecting the Space Environment*, in *46th Colloquium L. Outer Space*, 2003, 14. See also: Supplement No. 10 (A/56/10), *Report of the International Law Commission on the Work of its Fifty-third Session*, 2001.

[3] UNGA Res. 41/65 of 3 December 1986, Principles Relating to Remote Sensing of the Earth from Space.

[4] According to Article 1 of the Draft Articles on Responsibility of States for Internationally Wrongful Acts: "Every internationally wrongful act of a State entails the international responsibility of that State".

the right to obtain the compliance of the primary obligation violated, as well as to punish the illegal behaviour.

If compared with the liability regime, the two notions have to be completely distinguished, the former having an *ex post* approach (except for the guarantee of non-repetition) and referring to the national *activities* of the State, while the latter showing both an *ex ante* and an *ex post* approach, as well as referring to the *damages* caused by a national space object.

Nevertheless, distinction does not imply that the two regimes cannot intersect. Specifically, if the State acted diligently, taking all the appropriate measures to avoid harm or to mitigate its consequences when the risk materialised, but the damage occurred nonetheless, *only liability* will be applied. However, if these due diligence obligations are breached, the regime of international responsibility for wrongful acts will be activated, in connection with the liability one, as referred in Article VII of the Outer Space Treaty and specified in the 1972 Convention on International Liability for Damages Caused by Space Objects framework.

As a matter of fact, particularly from the environmental perspective, the breach by a State of its due diligence obligations, resulting in a significant damage caused to the environment of other States or of areas beyond national jurisdiction, determines State legal responsibility.[5]

Finally, also their consequences are different, the former expecting restitution, or compensation including both the actual damages and lost profits, satisfaction and guarantees of non-repetition, the latter leading only to a compensation for the damage suffered, once the harm has occurred, which is lower than the compensation provided under the responsibility regime.[6]

2.1.1 Constitutive Requirements of Internationally Wrongful Act: Subjective Element

Concerning, the sources of the international responsibility regulation, this is governed by international customary law. However, in order to have more order in the exposition, the present work will rely on the Draft Articles on Responsibility of States for Internationally Wrongful Acts (ILC Draft Articles), adopted by the International Law Commission in 2001.[7] As a matter of fact, these 59 articles are the result of both international customary rules and international law development, embracing both the constituent elements and the consequences of any wrongful act.

[5] I.C.J. Reports 2010, Case concerning Pulp Mills on the River Uruguay (Argentina v. Uruguay).

[6] In this view, the liability system is instrumental to ensure an adequate allocation of loss in case of damages caused by ultra-hazardous activities.

[7] Draft Articles on Responsibility of States for Internationally Wrongful Acts, 2001. See also: Report of the International Law Commission at its 53rd Session. In the present work, it will be referred as the ILC Draft Articles.

In this view, they provide a model applicable, in principle, for the breach of any international rule of law.

First of all, in order to ascertain the existence of an international responsibility, two conditions should be satisfied: the act should be ascribable to a State, according to international law, and there should be a breach of an international obligation resting on the State at the time of the act commission. As a matter of fact, according to Article 2 of the ILC Draft Articles: "There is an internationally wrongful act of a State when conduct consisting of an action or omission: (a) is attributable to the State under International Law; and (b) constitutes a breach of an international obligation of the State".[8] In this view, it might be referred to these two requirements as a subjective element and an objective one.

Concerning the subjective element, as a general rule, a "human action" can be considered a "State action" only when it is accomplished by an agent of the State which has acted in such a role.[9] However, in the international space law regime, this complex mechanism of attribution is circumvented through Article VI of the Outer Space Treaty.

Even if at a first glance it might be argued that the term "responsibility" simply recalls the notion of international responsibility for wrongful acts, this interpretation is not correct. Rather, this expression produces the attribution of private space activities on the national State.[10] In this view, the Outer Space Treaty guarantees that States cannot escape their legal obligations under international law claiming that an activity is carried out through the medium of international organisations or non-governmental bodies. For this reason, some authors referred to the responsibility in the space law field as objective responsibility, since the "objective" responsible subject is not necessarily the direct author of the wrongful act, but rather it is "under the obligation to assume the consequences of it by virtue of its determinant position in relation to the activity at the origin of the harm. (Therefore) it [the responsible subject] is responsible, automatically and independently of any wrongful act".[11]

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[8] Ibidem.

[9] This legal operation, through which the conduct of a physical person, whether it be an action or omission, is qualified as a "State action" is called "attribution".

[10] In order to have a full explanation of the principle recalled here, the author refers back to the original version of Condorelli: "[…] On a voulu, d'une part, soumettre les États à des obligations spécialement lourdes de surveillance et de contrôle, d'autre part, leur faire supporter la responsabilité internationale pour tout fait illicite spatial susceptible d'être perpétré au cours des activités en question. Dans ce but, non seulement on a renforcé, ici, de façon éclatante, l'obligation de type classique de "diligence due", mais on a assorti celle-ci d'une règle spéciale (dérogeant aux principes communs sur l'imputation des faits illicites […]) d'après laquelle les comportements spatiaux des particuliers sont intégralement assimilés à ceux des organes et des entités de l'État, donc imputés à celui-ci". See: Luigi Condorelli, 'La Réparation des Dommages Catastrophiques Causés par les Activités Spatiales', in *La Réparation des Dommages Catastrophiques. Les Risques Technologiques Majeurs en Droit International et en Droit Communautaire* (Travaux des XIII[es] Journées d'Études Juridiques Jean Dabin Organisées par le Département de Droit International Charles De Visscher, Université Catholique de Louvain 1990) 270.

[11] This is also the reason why such kinds of responsibility are usually connected to a compulsory insurance system. See: Céline Négre, 'Responsibility and International Environmental Law', in

Nevertheless, a large debate has surrounded the meaning of "national activities" and the "appropriate State", since according to the textual interpretation the "national State" seems to bear international responsibility for its national activities, while the "appropriate State" should authorise and supervise such activities. Specifically, the problem has been to establish if these two States were *different* States.

If the responsibility for activities carried on by governmental agencies does not raise significant issues, in the case of activities carried on by non-governmental entities, the answer is not that univocal. In this view, the most appropriate approach is to determine State responsibility by general aspects of public international law, i.e. "a State has jurisdiction over any activity that is carried on from its territory as well as over any activity that is carried on by its nationals (natural or juridical persons). […] Responsibility is to be understood in terms of Article VI i.e. the State whose nationals undertake the activity (i.e. the launching or the operation of the object that is going to be launched) or from whose territory such activity is undertaken".[12]

In light of this interpretation, the State which will register the object in its national register will become the State of registry, retaining then jurisdiction and control over the space object, and the State which retains jurisdiction and control over the space object will also be the one able to claim requirements and conditions in the operation of that object, authorising the activity.[13]

Accordingly, it might be presumed that the appropriate State, usually, will also correspond to a national one,[14] so that the national State will have three main obligations: to authorise private activities, to supervise such activities and to guarantee that these activities will be consistent with the Outer Space Treaty provisions.[15]

This is the interpretation which seems to be supported also by the *travaux préparatoires* of the Outer Space Treaty which do not show any deviation from the general concepts of public international law and by State practice.[16]

James Crawford, Alain Pellet, Simon Olleson (eds.), *The Law of International Responsibility* (OUP 2010) 807.

See also: Benedetto Conforti, *Diritto Internazionale* (10th edn., Editoriale scientifica 2010) 405.

[12] Stephan Hobe, Bernhard Schmidt-Tedd, Kai-Uwe Schrogl, *Cologne Commentary on Space Law: Outer Space Treaty*, vol. 1 (1st edn., Carl Heymanns 2009) 112.

[13] IDEM.

[14] Marco Pedrazzi, 'Outer Space, Liability for Damage', *Max Planck Encyclopedia of Public International Law* (2008) 2.

[15] Marco Pedrazzi, *Danni Causati da Attività Spaziali e Responsabilità Internazionale* (1st edn., Giuffré 1996) 36.

[16] For more information, visit the United Nations Office of Outer Space Affairs website: http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/travaux-preparatoires/outerspacetreaty.html

2.1.2 Objective Element

The second fundamental requirement of the international wrongful act is the breach of an international obligation, i.e. the contrast between the behaviour kept in practice by the responsible State and that which was required according to the international rule of law violated.

As a matter of fact, as stated by Article 12 of the ILC Draft Articles: "There is a breach of an international obligation by a State when an act of the State is not in conformity with what is required of it by that obligation, regardless of its origin or character".[17]

In this view, from this provision, two elements emerge: first of all, the irrelevance of the origin of the international obligation breached, secondly, that it is the content of the primary norm violated to determine whether an act is wrongful or not.

According to the ILC Commentary to the Draft Articles, obligations may arise for a State by a treaty and by a rule of customary international law or by a treaty and a unilateral act.[18]

As the ILC Draft Articles underline, international responsibility is not divided between contractual (*ex contractu*) and delictual (*ex delicto*) responsibility.[19] As a matter of fact, as stated by the International Court of Justice (I.C.J.) in the 1997 case concerning the Gabčíkovo – Nagymaros Project: "It is […] well established that, when a State has committed an internationally wrongful act, its international responsibility is likely to be involved *whatever the nature of the obligation it has failed to respect*".[20] In this view, from the choice of words both in the ILC Draft Articles and in the I.C.J. statement, the expression "breach of an obligation" rather than "breach of a rule" or of a "norm" underlines that what matters in the context of responsibility is not the existence of a norm in an abstract form. Rather what counts is *the existence of an obligation in concrete circumstances*. In other words, this means that where an internationally wrongful act took place, the origin of such an obligation does not change the fact.[21] The question does not seem to be merely dialectical, since it is instrumental to understand that the regime of responsibility is unique for all breaches of obligation, without the rise of different regimes of responsibility in the view of the different sources which generated the obligations violated.[22]

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[17] See footnote n. 7.

[18] ILC Commentary to the Draft Articles on Responsibility of States for internationally Wrongful Acts, 2001, para. 4, 126.

[19] As a matter of fact, also the International Law Commission in the 2001 Draft Articles avoided to recall the distinction, proposed in the 1996 Project of Articles, between international crimes and international delicts.

[20] I.C.J. Reports 1997, *Case Concerning the the Gabčíkovo – Nagymaros Project* (Hungary – Slovakia), 25 September 1997, para. 47, 38.

[21] Yumi Nishimura, 'Source of the Obligation', in James Crawford, Alain Pellet, Simon Olleson (eds.), *The Law of International Responsibility* (OUP 2010) 368.

[22] However, it should be noted that "no specific regime" does not mean that the regime of State responsibility would not differ according to the substantive content of the obligation violated or the

2.1.2.1 Primary Norm Violated: The Obligation of Means

At this point, therefore, it is essential to identify the primary norm violated, from which it would have derived an obligation of the State to act or to refrain from engaging in a particular conduct.

In international law, different types of obligations might be distinguished: conventional or customary obligations, according to their sources; positive or negative obligations, according to their content; and preventive or repressive obligations, according to the specific goal of each obligation.

However, these obligations are not relegated in autonomous compartments, since an international obligation usually presents different features simultaneously.

For this reason, when a breach of international obligations should be verified: "The principal focus will be on the primary obligation concerned. It is this which has to be interpreted and applied to the situation, determining thereby the substance of the conduct required, the standard to be observed, the result to be achieved […]".[23]

Starting from this setting, it should be understood from which primary norm these obligations arise and what types of obligations are violated when space pollution occurs.

In order to do so, it might be helpful to consider space pollution, regarded as a threat for the outer space environment per se, as an environmental concern. In this view, it should be argued that environmental responsibility within the framework of environmental law usually results in a violation of customary obligations. In this regard, it might be the Outer Space Treaty to crystallise already existing customary rules of law, in this specific case the principle of due diligence in space activities, with Article IX, and the principle of equitable access to outer space, ex Article I, both intended as a specification of the general principle of sic *utere tuo ut alienum non laedas*, i.e. the obligation to exercise each own right without prejudice for other subjects' interests.[24] Moreover, the UN Space Debris Mitigation Guidelines adopted by the United Nations Committee On the Peaceful Uses of Outer Space (UN

particular relationship created by international obligation (i.e. if the obligation is only between the Parties or it is an *erga omnes* duty). As a matter of fact, these features of the obligation breached will be reflected by the content of the responsibility and the legitimacy to invoke it.

[23] ILC Commentary to the Draft Articles on Responsibility of States for internationally Wrongful Acts, 2001, para. 2, 123.

[24] In order to have a full explanation of the principle recalled here, the author refers back to the original version of Carbone, Luzzatto and Santa Maria: "(I principi generali) esprimono immediatamente certe specifiche caratteristiche della struttura del sistema giuridico nel quale la società internazionale è organizzata. […] Possono essere considerati […] come ricavati in via induttiva da regole consuetudinarie, e partecipano dei caratteri propri di queste quanto ai loro elementi costitutivi ed al loro valore formale: non esiste, dunque, alcuna differenza di posizione gerarchica delle due categorie di regole. […] Si tratta altro che di una particolare categoria di norme consuetudinarie". See: Riccardo Luzzatto, 'Il Diritto Internazionale Generale e le Sue Fonti', in Sergio M. Carbone, Riccardo Luzzatto, Alberto Santa Maria (eds), *Istituzioni di Diritto Internazionale* (5th edn., Giappichelli Editore 2016) 52.

COPUOS)[25] would serve to establish a standard of care in the exercise of the due diligence required for the conduct of outer space activities.

In International Environmental Law, the first step in the examination of the breach of the international primary norm, is to ascertain whether the State acted according to the due diligence principle. In this view, the content of the obligation of prevention is not limited to the duty to supervise its nationals' activities, which is an obligation of means, but also every State is barred from *voluntarily* causing a significant ecological harm, not only to the territory of another State but also to areas beyond national control.[26] In this regard, the duty to prevent is also an obligation of result.[27]

Therefore, from the "means" perspective, the State has the *obligation to control*. In this view, the authorising and supervising State will have to guarantee that all the measures expected from a "good government" not to cause damage have been taken.[28]

In the space law field, such measures might be a set of compulsory systems and procedures to avoid space debris, as well as mitigation measures when the debris generation cannot be avoided at all.[29] As a matter of fact, according to the working group of the International Law Commission in its 1978 report: "The essential obligation owed by a State in such a context has tended to be conceived as one of moderation, or of care or due diligence, in relation to its own activities or of private activities within its jurisdiction or control".[30] In this view, States have the duty to ensure that the harmful activities of their nationals are conducted with due regard for other States interests, as well as for their duties under International Law. National laws licensing are the means by which States fulfil their obligation to control their nationals' activities. However, these national laws should meet certain requirements, specifically the limits of the Outer Space Treaty provisions and those of international law.[31]

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[25] UN doc. A/62/20, Annex to the Report of the Committee on the Peaceful Uses of Outer Space, i. e. UN Space Debris Mitigation Guidelines, 2007.

[26] See: I.C.J. Reports 1996, Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, para. 29, p. 242.

[27] In this view, it should be noted that in the field on environmental law, generally obligations are conceived as obligations of conduct. See: Gerhard Hafner, Isabelle Buffard, 'Obligations of Prevention and the Precautionary Principle', in in James Crawford, Alain Pellet, Simon Olleson (eds.), *The Law of International Responsibility* (OUP 2010) 530.

[28] As a matter of fact, although in international law there is not an explicit obligation to avoid causal damage to other States space assets, however there should be the duty to observe a standard of care or due diligence in performing space activities. See: Joyeeta Chatterjee, 'Legal Issues Relating to Unauthorised Space Debris Remediation', paper presented at the *65th International Astronautical Congress* held in Toronto, 2014.

[29] In this view, spacecrafts disposal and active debris removal techniques are efficient means of mitigation.

[30] *Yearbook of the International Law Commission*, 1978, vol. 2, para. 19, 151.

[31] This means that: "(Advertising, but it might be replaced by) Activities that would so substantially clutter the orbit that it would become impossible for other States to explore outer space would likely violate International law" and that where authorisation was issued despite such a risk, the

At this point, two might be the options: if the State implemented all the precautions necessary to avoid harmful contamination, the international subject might be considered discharged by its due diligence obligation. In this case, if harm occurs nonetheless, the State will be considered only *liable* under international law. On the other side, if the State did not comply with its due diligence obligation, i.e. in case of a totally absence of such measures, the obligation of means grounded by the primary norm would be breached.

As a matter of fact, the purpose of the due diligence principle is to oblige the space-faring nation to have "a much higher standard of care in designing policies and a much higher degree of vigour […] to enforce them".[32] In this view, the responsible State will be *liable*, if harm occurs, *and responsible* for the breach of an international obligation, at this time regardless of whether the damage occurred or not.[33]

As a consequence, the defaulting State will be subject to *objective* responsibility.[34] In this regard, such a qualification has three main consequences: responsibility is engaged directly by the occurrence of the harm, the victim will not have to demonstrate the breach of the law and the responsible subject will not be necessarily the direct author of the damage, although it will be "under an obligation to assume the consequences of it by virtue of its determinant position in relation to the relevant activity at the origin of the harm. It is responsible automatically […]".[35]

2.1.2.2 Obligation of Result

Moreover, there may be another case of internationally wrongful act, always grounded on these primary norms of international law, which relies on the international *obligation of result*. Indeed, the obligation to supervise corresponds with the obligation of every State to refrain from voluntarily causing a significant ecological harm to the environment also in areas beyond national jurisdiction.

The problem is that usually pollution is inherent to space activities, which may imply that a State took all the appropriate measures to avoid space debris generation,

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authorising State would be in breach of its international obligations and arguably have committed an internationally wrongful act". See: Jai Galliott, *Commercial Space Exploration: Ethics, Policy and Governance* (1st edn., Routledge 2015) 102.

See also: Frank J. Balsamello, 'When You Wish Upon a Falling Billboard' (2010) 28 Geo. L. J. 1785.

[32] United Nations, International Law Commission, *Yearbook of the International Law Commission*, 1996, vol. 2, part. 2, 111.

[33] "If international responsibility is ruled out (in case of conventional mechanisms), it nevertheless reappears in cases of persistent failure, although […] adapted to damage to the global environment in the framework of "non-compliance" procedures". See: Nègre (n.11) 809.

[34] This way, all the difficulties linked to the proof of the internationally wrongful act, i.e. the breach of the obligation of prevention and the casual link between the negligence and the harmful consequences suffered, will be avoided.

[35] Nègre (n.11) 807.

but space pollution occurred nonetheless. In this view, as demonstrated before, the State will be only liable.

However, as it might be easily observed, in every civil system beside the notion of pollution, there is usually the concept of tolerance threshold.

This last element is particularly important, since it might be a contradiction to act like a "good government", nationally adopting all the appropriate due diligence standards for space activities, but then to carry out an anti-satellite test (ASAT) which *alone* produces an amount of debris which might be, for instance, ten times higher than the one avoided by the State through the national implementation of mitigation measures. As a matter of fact, a serious danger to the outer space environment arises from the development of space weapons, the worst source of intentional space debris production.

In this view, the level of tolerance comes from Article I of the Outer Space Treaty, according to which the breach of the obligation of conduct is fulfilled when the environmental degradation of outer space results in a *significant amount* of new pieces of space debris, which in practice prevents the equitable access and utilisation of outer space.

From this perspective, the result perspective more precisely, it is mainly a particular conduct to be qualified as a wrongful act according to the 2001 ILC Draft Articles: the intentional destruction of space systems, i.e. the deliberate production of space debris from a space-faring nation, which may cause *serious contamination* for the outer space environment per se, which could be potentially irreversible.

Anti-satellite tests, being hazardous activities, may pollute the outer space environment with long-lasting and hazardous debris, specifically high-altitude debris, causing the unavailability of vast orbital regions, both for use or transit, in this view violating the international customary rule to leave free access to space as well as the equitable utilisation of a common resource.

Moreover, the ASAT tests, more than any other threat to the outer space environment, do not imply a mere *de minimis* harm. Rather, a *significant* injury to the outer space environment is inherent to such activities, going to affect *all* the States involved in outer space activities. As a matter of fact, their consequences would fall not only on the directly damaged ones but, having very long-term effects, they would weigh also on the future generations of space actors, whose legitimate interest in the preservation of the outer space environment should be safeguarded.[36]

However, it should be underlined that even though these activities are hazardous activities which inevitably bring with them some risks, they are per se perfectly legal. As a matter of fact, these tests represent the legitimate implementation of Article 51 of the Charter of the United Nations, according to which: "Nothing in the present Charter shall impair the inherent right of individual or collective *self-defence*"[37] and of Article VIII of the Outer Space Treaty, which enshrines the right

[36] David A. Koplow, 'Asat-isfaction: Customary International Law and the Regulation of Anti-Satellite Weapons' (2008) 30 Mich. J. Int'l L. 1187–1272.

[37] Charter of the United Nations (1945).

of States Parties to dispose of their own satellites, including the right to destroy their space objects.[38]

For this reason, the legality or illegality of these activities should not be grounded on the risk they may involve, but rather on the concrete violation of the primary international obligation.[39]

An example may help to clarify this reasoning. In 2007 the People's Republic of China led an anti-satellite test, destroying its nonoperational weather satellite, Fengyun-1C (FY-C1). One year later, the United States announced that they were planning an anti-satellite test, and after a few days they repeated the same test, destroying a derelict satellite which was decaying out of orbit and coming back to Earth.

At first glance, it may seem that the conducts of the two States were identical, but it is not so. As a matter of fact, China destroyed its satellite at an altitude of 863 km in a direct ascent attack, while the United States destroyed their spacecraft at an altitude of 214 km.

More specifically, the United States openly recognised that their experiment would have created harmful contamination, in the meaning of Article IX of the Outer Space Treaty, and *took measures to avoid* it by intercepting the satellite in a decaying orbit placed at a low altitude and, thus, minimising the uprising of space debris.

On the opposite, China did not conduct its test trying to mitigate the production of space pollution, using low decaying orbits or inclinations able to minimise the harmful contamination.

As a result, the experiment introduced thousands of new debris both in the polar and in the Low Earth orbits, deeply modifying their environment and making their use more dangerous for future operations.[40]

In this view, it might be maintained that if, on the one side, the United States discharged themselves from their due diligence obligation, China did not. As a matter of fact, if, on the one side, China breached its international obligation of means, without providing appropriate preventive measures, shaped on the due diligence principle, on the other side, it violated its connected obligation of result, causing harmful contamination and prejudicing the principle of equitable access to outer space.

[38] Article VIII of the Outer Space Treaty states: "A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object […] while in outer space […]. Ownership of objects launched into outer space […], and of their component parts, is not affected by their presence in outer space […]".

[39] In legal theory there is a distinction between *lex lata* and *lex ferenda*, the former referring to law "as it is", the latter representing the law as "it ought to be". In this view, only from *lex lata* descends the legality or illegality of an action.

[40] T. S. Kelso, 'Analysis of the 2007 Chinese ASAT Test and the Impact of its Debris on the Space Environment', paper presented during the 2007 Amos Conference held in Maui, Hawaii.

2.2 Legitimacy to Invoke State Responsibility

Having now defined the rules establishing the conditions under which international responsibility arises and the content of the State's reparative conduct, the States against which such obligations are due, i.e. thus those entitled to invoke State responsibility, should be identified.

The general principle formalised by Article 42 of the ILC Draft Articles states that: "A State is entitled as an injured State to invoke the responsibility of another State if the obligation breached is owed to: (a) that State individually; or (b) *a group of States* including that State, or the *international community as a whole*, and the breach of the obligation: (i) specifically affects that State; or (ii) is of such a character as radically to change the position of all other States to which the obligation is owed with respect to the further performance of the obligation".

However, in case of breach of a duty to prevent the outer space environment per se from pollution, it might be difficult to identify who should be considered the "injured State", under Article 42 of the ILC Draft Articles, specifically because the ILC provision seems to refer only to those States whose interests and rights have been *directly* affected by the internationally wrongful act.[41]

In this view, it might be Article 48 of the ILC Draft Articles to offer a solution, establishing that: "Any State other than an injured State is entitled to invoke the responsibility of another State […] if: (a) the obligation breached is owed to a group of States including that State, and is established for the protection of a collective interest of the group; (b) the obligation breached is owed to the international community as a whole".

However, first of all, it should be clarified the meaning of "States other than the injured one". As a matter of fact, two may be the options: this expression refers to third parties absolutely not affected by the illegal conduct, or this terminology indicates a State which has been affected by the wrongful act outside the Article 42 conditions, i.e. it has suffered only an indirect prejudice.

In this view, only the second solution should be the correct one.

Once understood the beneficiaries of this provision, this should be applied to outer space actors. In this view, if the States Parties to the 1967 OST may be included in the category provided by subparagraph 1(a), whose main purpose is to foster a common interest, over and above any interests of the States concerned individually, the question may be whether States non-parties fall under paragraph 1(b) of the ILC Draft Articles.[42]

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[41] Marchisio (n.2) 15.

[42] However, it should be noted that actually, in practice, the distinction between the two categories may be blurred. As a matter of fact, if it is true that generally speaking environment protection obligations fall under the former category, being regulated through regional conventional instruments, thus operating on the basis of reciprocity, they may overlap with the latter classification, as far as the regional mechanism incorporates the *erga omnes* obligations. See: Antonio Cassese, 'Grave Breaches of Obligations Owed to the International Community as a Whole: the Character of the Violation', in James Crawford, Alain Pellet, Simon Olleson (eds.), *The Law of International Responsibility* (OUP 2010) 415–421.

The question is to verify whether the obligation breached, through the generation of space pollution, is owed to the internationally community as a whole, in the view of the importance of the rights involved, or not.

As a matter of fact, the so-called obligations *erga omnes* are inherent to the international community itself and are by definition collective obligations protecting the interests of the international community per se.

In this view, Article 48 of the ILC Draft Articles provides a specific rule for the breach of obligations serving the *community interest*. Indeed, this aspect of the mentioned involves a measure of progressive development, justified by the fact that it provides a means of protection for the community (or collective) interest at stake.[43]

From the international space law perspective, the answer may come from an example of community interest, i.e. the interest in the protection of common spaces. As a matter of fact, the protection of these sources is usually achieved through the internationalisation of these spaces, thus excluding them from national jurisdiction.[44] In this view, internationalisation aims at leaving these spaces free for exploration and use, as well as protecting the interests of the future generations.[45]

In this sense, remembering that outer space is a *res communis omnium*, and enhancing the role of Article I and IX of the Outer Space Treaty[46] in preserving not only the free access to such an environment but also its preservation for the future generations of space actors, it may be maintained that the protection of outer space could fall under the scope of subparagraph 1(b) of Article 48 of the ILC Draft Articles, its protection representing a common interest of the whole community.[47]

Moreover, even narrowing the protection offered by the aforementioned Article 48 only to those breaches concerning the involvement of human rights, as reminded by the 1972 United Nations Conference on the Human Environment, namely, the

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[43] ILC Commentary to the Draft Articles on Responsibility of States for internationally Wrongful Acts, 2001, para. 12, 323.

[44] Isabel Feichtner, 'Community Interest', *Max Planck Encyclopedia of Public International Law* (2007) 6.

[45] For the intersection between environment protection and sustainable development, see: Edith Brown Weiss, 'Our Rights and Obligations to Future Generations' (1990) 84 Am. J. Int'l L. 198–207.

[46] Annex to the UNGA Res. 2222 (XXI) of 19 December 1966, *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*.

In the present work, it will be referred as the Outer Space Treaty.

[47] This theory, according to which international obligations for the environmental protection may have an *erga omnes* effect, seems to be shared also by Lotta Viikari which adds: "This (assumption) holds true in particular if the erga omnes character of obligations is not determined narrowly by whether all States have standing to bring proceedings before an international tribunal in the event of a breach, but on the basis of a right or ability of the international community to hold an individual State accountable for compliance with the obligations through other institutions, such as the Conference of the Parties […] in case of climate changes". Lotta Viikari, *The Environmental Element in Space Law: Assessing the Present and Charting the Future* (Brill/Nijhoff 2008) 140–141.

Stockholm Conference, also environmental protection is a necessary condition for the promotion of peace, human rights and development, so that since outer space may be totally included under the notion of environment,[48] also its protection should be a necessary condition for humankind development.

Finally, concerning the type of conduct that these States may invoke, States' entitlement is limited to the claim of the unlawful conduct cessation, guarantees of non-repetition and compliance with the breached obligation.[49]

2.3 Conclusions: Consequences of State Responsibility

According to Article 30 of the ILC Draft Articles: "The State responsible for the internationally wrongful act is under an obligation: (a) to cease that act, if it is continuing […]".

In this view, the first consequence of the international responsibility is the obligation of cessation of the wrongful act.[50] However, cessation may also be seen as a late compliance of the international obligation originally breached.[51] In this perspective, as noticed by the International Law Commission "cessation is situated […] in between the two categories of rules",[52] primary and secondary ones.

Therefore, the consequences of this violation have to be determined by reference to the obligation violated, so that the cessation must take the form of an action or an omission.

Concerning space debris, the obligation of cessation should refer more generally to the duty to avoid space pollution, and more specifically to the arrangement of national regulations concerning space debris mitigation as well as spacecraft disposal systems, when the breach of the international obligation involves the State duty to supervise its nationals' activities (obligation of means).

On the other hand, when the State has complied with its obligation of means but intentionally produced a serious hazard for the space environment engaging in missile tests without complying with its due diligence duty (conducting them, for

[48] Laura Pineschi, *La Protezione dell'Ambiente in Antartide* (1st edn., Cedam 1993) 30.

[49] Luigi Fumagalli, '*Illecito e Responsabilità*', in Sergio M. Carbone, Riccardo Luzzatto, Alberto Santa Maria (eds), *Istituzioni di Diritto Internazionale* (5th edn., Giappichelli Editore 2016) 52.

[50] For the theory maintaining that the obligation of cessation should be considered as a secondary rule, see: Karl Zemanek, 'La Responsabilité des États pour Faits Internationalement Illicites ainsi que pour Faits Internationalement Licites', in Prosper Weil, *Responsabilité Internationale* (1st edn., Éditions A. Pedone 1987) 65.

[51] In this view, the obligation of cessation is a form of implementation of the principle *pacta sunt servanda*, because the State is owed to respect its international obligations. For the theory that the obligation of cessation should be considered a primary obligation, see: Christian Dominicé, 'Observations sur les Droits de l'État Victime d'un Fait Internationalement Illicite', in Weil (n.50) 27.

[52] *ILC Yearbook 1993*, Commentary to Draft Articles, para. 4, 55.

instance, on high or deeply crowded orbits), the obligation of cessation might not be easily distinguished by the obligation to make reparation.

The second consequence of international responsibility is the obligation to entirely make reparation. Indeed, in all legal systems, the notion of responsibility implies the substitution of a primary obligation by a secondary or subsidiary obligation, i.e. to make reparation for the consequences of the breach. As underlined by the Permanent Court of International Justice in the Factory at Chorzów case: "It is a principle of international law that the breach of an engagement involves an obligation to make reparation in an adequate form. Reparation therefore is the indispensable complement of a failure to apply a convention and there is no necessity for this to be stated in the convention itself. Differences relating to reparations, which may be due by reason of failure to apply a convention, are consequently differences relating to its application".[53] Moreover, the Permanent Court added: "The essential principle contained in the actual notion of an illegal act, a principle which seems to be established by international practice […], is that *reparation must*, so far as possible, *wipe out all the consequences of the illegal act and re-establish the situation which would*, in all probability, *have existed if that act had not been committed*".[54]

In this view, the form of reparation which is most suitable for space debris remediation is restitution in kind (*restitutio in integrum*), i.e. the re-establishment of the situation existing before the wrongful act was committed (*status quo ante*).[55]

However, it might be contested that it is difficult to establish in what way a restitution in kind will be feasible in outer space, once a State has harmfully contaminated some orbital regions.

It is not so. Rather it might be argued that this mechanism actually finds its greatest potential in international space law.

As a matter of fact, if a new duty to restore the previous situation rested on the responsible State, this will entail that the State might be *obliged* to put in place active debris removal mechanisms.[56] In this view, the responsible States might be obliged to remove the debris they produced in breach of their due diligence obligations.

Moreover, also the temporal element plays a relevant role in this phase. Specifically, the distinction between an "instant" and a "continuous" breach is not merely theoretical. As stated by the arbitral tribunal in the Rainbow Warrior case: "(On the contrary) it has practical consequences, since the *seriousness* of the breach and its *prolongation* in time cannot fail to have *considerable bearing on the*

[53] PCIJ Reports, Series A, *Factory at Chorzów (Jurisdiction)*, 26 July 1927, No. 9, 21.

[54] PCIJ Reports, Series A, *Factory at Chorzów (Merits)*, 13 September 1928, No. 17, 27.

[55] In this view, Article 35 of the ILC Draft Articles establishes: "A State responsible for an internationally wrongful act is under an obligation to make restitution, that is, to re-establish the situation which existed before the wrongful act was committed […]".

[56] Peter Malanczuk, 'Review of the Regulatory Regime Governing the Space Environment. The Problem of Space Debris', in (1995) 38 Colloquium L. Outer Space, 355–382.

See also: Stephan Hobe, 'Environmental Protection in Outer Space: Where we Stand and What is Needed to Make Progress with Regard to the Problem of Space Debris' (2012) 8 The Indian J. L. & Tech. 1–10.

establishment of the reparation which is adequate for a violation presenting these two features".[57]

Specifically, when the violated obligation requires the State to prevent the occurrence of a given event, the violation takes place *at the moment* when such an event occurs and *extends* for the whole period in which the event produces its effects, contrasting with the content of the violated obligation.[58]

Moreover, as reminded by the arbitral tribunal, it is indisputable that the features of the wrongful act, i.e. the seriousness and the prolongation, will affect the determination of the obligation of reparation. Specifically, the seriousness of space pollution, as well as its consequences in the long term, will be balanced when the obligation of restitution will be regarded in light of the limits settled by Article 35 of the ILC Draft Articles, according to which restitution should not be materially impossible and it should not involve a burden out of all proportion to the benefit deriving from restitution instead of compensation.[59]

Finally, as a closing provision, Article 32 of the just mentioned Articles underlines that the obligation to make reparation should never be subject to restrictions arising from national law, stating that: "The responsible State may not rely on the provisions of its internal law as justification for failure to comply with its obligations under this Part".[60]

Through a stronger enhancement of the importance of Article VI of the Outer Space Treaty and a more defined delineation of the perimeter of its applicability, the 1967 Convention might become a truly enforceable framework, going to remediate its inherent vagueness which in the long term may risk to compromise the future exploration and use of the outer space environment.

The solution offered in this analysis might go to strengthen the States' obligation to prevent contaminating outer space, a duty which might be inferred from a joint reading of Articles I and IX of the Outer Space Treaty, creating an effective mechanism to ensure a long-lasting sustainability of outer space activities also for future generations and new developing actors.

This assumption may be particularly helpful not only in order to mitigate the production of space debris but also in the perspective of their remediation.

At the end of the day, if States have the international obligation to remove the debris they produced, perhaps a tragedy of commons will still be avoided.

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[57] Arbitral Tribunal, Rainbow Warrior (New Zeland vs. France), 30 April 1990, para. 101, 264.

[58] See footnote 42.

[59] In this view, probably, the costs of Active Debris Removal will be a criterion to evaluate the impossibility of States compliance.

[60] See footnote n. 7.

Chapter 3
Intentional Destruction of Satellites in Relation to International Peace and Security

Alexander Gairiseb

Abstract Some countries have developed antisatellite technology and deliberately destroy satellites. However, intentional destruction of satellites contributes to space debris, which is hazardous or deleterious, and disturbs the international community in the peaceful exploration and use of outer space. Therefore, the Security Council should exercise its discretionary powers conferred to it by the UN Charter to determine that intentional destruction of satellites is a threat to peace or breach of peace.

3.1 International Peace and Security Under UN Charter

The United Nations was established with the purpose of maintaining international peace and security, and to take effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace.[1]

The UN maintains international peace and security through the Security Council, which is the organ established within its setup.[2] In particular, in order to ensure prompt and effective action by the United Nations, the Security Council (herein referred to as the 'SC') is primarily responsible for the maintenance of international peace and security,[3] provided the Security Council acts in accordance with the purposes and principles of the United Nations.[4] Consequently, as part of its responsibility to maintain international peace and security, the Security Council can determine the existence of any threat to the peace, breach of the peace or act of aggression.[5] In addition, the Security Council can decide what measures should be taken in order to

[1] UN Charter, art.1, para.1.

[2] ibid. *a*rt.7, para 1.

[3] Ibid. *art.*24, para.1.

[4] Ibid. art.24, para.2.

[5] Ibid. art.39.

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A. Froehlich (ed.), *A Fresh View on the Outer Space Treaty*, Studies in Space Policy 13, https://doi.org/10.1007/978-3-319-70434-0_3

maintain or restore international peace and security.[6] On the one hand, the Security Council may decide to take measures that do not involve the use of armed forces; this may include complete or partial interruptions of economic relations and of rail, sea, air, postal, telegraphic, radio and other means of communication and the severance of diplomatic relations.[7]

3.2 Concepts of Threat to Peace or Breach of Peace

The UN Charter as it stands does not contain the definition of the concept of threat to peace, breach of peace or act of aggression. However, the concept of aggression was defined in the General Assembly Resolution 3314 (XXIX) of 14 December 1974 as 'the use of armed forces by a State against the sovereignty, territorial integrity or political independence of another State, or in any other manner inconsistent with the Charter of the United Nations'.[8] For the purpose of this analysis, the author will focus on the first two concepts.

As alluded to earlier, the concepts of threat to peace or breach of the peace are not defined within the UN Charter. However, even if the Charter does not define these concepts, the ordinary meaning should be given to the terms of the treaty in their context and in the light of the object and purpose of the treaty.[9] But when we consider the fact that the UN Charter was concluded before the entry into force of the Vienna Convention on the Law of Treaties, we could deduce that the provisions of the Convention, namely, the rules of interpretation in Article 31 and 32, will not apply to the UN Charter.[10] On the contrary, the UN Charter is a constituent instrument of an international organization; thus the Vienna Convention applies to it even if the UN Charter was concluded before the entry into force of the Vienna Convention,[11] not to mention that the rules of interpretation of treaties acquired the status of customary international law which applies to all States generally. Consequently, the provisions of Article 31 and 32 of the Vienna Convention will be utilized in the interpretation of the concepts of threat to peace or breach of peace in this article.

However, I should stressed that it is not the purpose of this analysis to provide a detailed interpretation of the UN Charter but just to provide or substantiate the link

[6] Ibid.

[7] Ibid. art 0.41.

[8] G.A. Res. 3314, U.N. GAOR at 142, U.N. Doc. A/9619 (1974).

[9] Vienna Convention on the Law of Treaties U.N.T.S. (1969), *entered into force* 27 Jan. 1980, Art. 31, para.1.

[10] Ibid. art.4.

The Vienna Convention entered into force in 1980, whereas the UN Charter was concluded in 1945.

[11] Ibid.art.5.

between intentional destruction of satellites and the maintenance of international peace and security.

The ordinary meaning of the term threat according to the Oxford Dictionary denotes: '2. a person or thing likely to cause damage or danger'.[12] Meanwhile peace was defined as 'freedom from disturbance; tranquillity'.[13] In addition, the Oxford Dictionary defines the term breach as 'an act of breaking or failing to observe a law, agreement or code of conduct'.[14] On the other hand, Collins Dictionary defines the term breach of the peace as 'conduct creating or tending to create a disturbance of the public peace'.[15] Consequently, the ordinary meaning of threat to peace means a person or thing likely to cause damage or danger to freedom from disturbance, whereas breach of peace means the disturbance of the public peace.

Furthermore, when we consider the term threat to peace in the context,[16] and the object and purpose of the UN Charter, we can infer from the Preamble that the use of armed force except for common interest is the threat to peace and that tolerance and living together in peace with one another as good neighbours will not create disturbance to the public peace. Furthermore, the object and purpose of the UN Charter is to maintain international peace and security. As well as to solve by peaceful means, adjust or settle international disputes or situations, which might lead to a breach of the peace. Consequently, the context and object and purpose of the UN Charter dictate that threat to peace or breach of peace is any person or thing likely to endanger international peace and security or the conduct that disturbs international peace and security.

The adoption of the ordinary meaning of the term threat to peace or breach of peace does not warrant for the consideration of the supplementary means of interpretation for the purpose of this analysis.

[12] University Oxford Press, 'Oxford Dictionaries – Definition of Threat' (2017) https://en.oxforddictionaries.com/definition/threat accessed 28 July 2017.

[13] University Oxford Press, 'Oxford Dictionaries – Definition of Peace' (2017) https://en.oxforddictionaries.com/definition/peace accessed 28 July 2017.

[14] University Oxford Press, 'Oxford Dictionaries – Breach' (2017) https://en.oxforddictionaries.com/definition/breach accessed 28 July 2017.

[15] Collins, 'Collins Dictionary – Breach of Peace' (2017) https://www.collinsdictionary.com/dictionary/english/breach-of-the-peace accessed 28 July 2017.

[16] The context of the UN Charter comprise of the text, including its preamble and annexes:

(a) Any agreement relating to the treaty which was made between all the parties in connexion with the conclusion of the treaty.
(b) Any instrument which was made by one or more parties in connexion with the conclusion of the treaty and accepted by the other parties as an instrument related to the treaty. As provided in Article 31 paragraph 2 of the Vienna Convention.

3.3 Existence of Threat to Peace or Breach of Peace

How does the Security Council determine the existence of threat to the peace, breach of the peace and act of aggression? The determination of the existence of threat to peace or breach of peace is left to the discretion of the Security Council. As a result, the threat to peace or breach of peace is what the Security Council says it is. Therefore, the Security Council can classify any situation as the threat to peace or breach of peace. At the inception of the UN, war was determined as a threat to peace; however, it is also relevant to consider that it was after the Cold War that new challenges and conflicts arose. For instance, the Security Council adopted several Resolutions determining the existence of threat to peace, which included serious violations of human rights, lack of democracy and anti-terrorist interventions as threat to peace.[17]

Therefore, the inference to be drawn is that any situation can be classified as threat to peace nowadays, because the circumstances that led to the conclusion of the UN Charter in 1945 were different compared to the ones arising in the twenty-first century.

3.4 International Peace and Security Under the OST

Similar to the UN Charter, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, herein referred to as the Outer Space Treaty (OST) does not contain the definition of the term peace. In addition, as discussed earlier, the Vienna Convention does not apply to the Outer Space Treaty in strict sense because the latter was concluded before the former came into entry. But as mentioned previously, the Vienna Convention principles of interpretation have accrued the status of rules of customary international law. Therefore, the ordinary meaning assigned to the term peace in the preceding section will be used throughout the paper.

In the context of Outer Space Treaty, the exploration and use of outer space, including the moon and other celestial bodies, should be carried out in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding.[18] In addition, the Outer Space Treaty stresses that 'the Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively

[17] Mónica Lourdes de la Serna Galván, 'Interpretation of Article 39 of the UN Charter (Threat to the Peace) by the Security Council. Is the Security Council a Legislator for the Entire International Community?' (2011) XI AnuarioI Mexicano de Derecho Internacional 166–172.

[18] Treaty on Principles Governing the Activities States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, UNOOSA (1966), *entered into force* 10 Oct. 1967, Art. III.

for peaceful purposes'.[19] The principle that outer space should be used for peaceful purposes is applicable to non-State parties to the OST on the basis that it is a rule of customary international law that is binding on international community in general.

Consequently, the OST furthers the object and purpose of the UN Charter for the maintenance of international peace and security. As well as the reiteration that if a situation arise in the exploration and use of outer space that is a threat to peace or breach of peace, then the Security Council can take necessary measures to maintain or restore international peace and security, including the determination that the exploration and use of outer space in the manner that is contrary to the principle outline within the OST amounts to threat to peace or breach of peace.

3.5 Intentional Destruction of Satellites Vis-à-vis Threat to Peace or Breach of Peace

Now, the intentional destruction of a satellite as a threat to peace or breach of peace will be the focus of this section. However a brief background will be provided on the issue of intentional destruction of satellites before we address the issue that the Security Council should determine that it (intentional destruction of satellites) exists as a threat to peace or breach of peace.

It is common cause that both the United States and the Russian Federation (former USSR) developed or renewed interest to develop antisatellite (ASAT) and missile defence systems in the 1950s–1960s, 1960s–1970s, 1980s–1990s and 2000s.[20] Now it is not the purpose of this analysis to go through the historical evolution of antisatellite weaponry, but China's ASAT test will be discussed briefly because it correlates with the purpose of this discussion. On 11 January 2007, at 5:28 pm EST, the PRC conducted its first successful direct ascent antisatellite (ASAT) weapons test, launching a ballistic missile armed with a kinetic kill vehicle (not an exploding conventional or nuclear warhead) to destroy the PRC's Fengyun-1C weather satellite at about 530 miles up in low Earth orbit (LEO) in space. The PLA conducted the test near China's Xichang Space Center in Sichuan province.[21]

As the result, in its resolution 62/217 of 22 December 2007, the General Assembly endorsed the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space and agreed that the voluntary guidelines for the mitigation of space debris reflected the existing practices as developed by a number of national and international organizations and invited Member States to implement those guidelines through relevant national mechanisms.[22]

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[19] Ibid. art. IV, para.2.

[20] Laura Grego, 'A History of Anti-Satellite Program' (2012) www.ucsusa.org/nuclear-weapons/space-security/a-history-of-anti-satellite-programs accessed 28 July 2017.

[21] Shirley Kan, 'China's Anti-Satellite Weapon Test. In Congressional Research Services Report for Congress' (2007) https://fas.org/sgp/crs/row/RS22652.pdf accessed 25 July 2017.

[22] UNCOPUOS, 'Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space' (2010) p iv.

Of particular importance is Guideline 4 that provides for the avoidance of the intentional destruction of any on-orbit spacecraft and launch vehicle orbital stages. Now, these guidelines are not legally binding yet; however, they can acquire the status of customary international law through State practice and *opinion juris* (sense of obligation).

Taking into account the ordinary meaning of the term threat to peace, it implies that intentional destruction of satellites can cause damage or danger, and the conduct can create disturbance of the public peace. Public, in this sense, means the international community. Consequently, intentional destruction of satellites disturbs the tranquillity that the international community enjoys in the exploration and use of outer space. Furthermore, the fragments that are generated from intentional destruction of satellites constitute a danger or the potential to cause damage to the satellites of other innocent bystanders. Therefore, no State can be at peace knowing that its satellites are at risk of exposure to danger as the result of intentional destruction of satellites.

The intentional destruction of satellites is equivalent to a person discharging a firearm at a public place. Such conduct is punishable under municipal laws even if the accused is the lawful owner of the firearm. The mere conduct of the accused disturbs public peace. Therefore, the same treatment can be assigned to the intentional destruction of satellites because such conduct is inconsistent with the object and purpose of the UN Charter. Secondly, it disturbs international community in the peaceful exploration and use of outer space.

Hence, the Security Council should exercise the discretion conferred to it under Article 39 of the UN Charter and determine that the intentional destruction of satellites is a threat to peace or breach of peace. The very fact that the exploration and use of outer space should be carried out in accordance with international law including the UN Charter, in the interest of maintaining international peace and security, is clear evidence that activities carried in outer space that threaten peace should be resolved by the Security Council by exercising the powers conferred to under Article 41. Thus, once the Security Council decides that intentional destruction of satellites is indeed a threat to peace, it should impose sanctions on the States that intentionally destroy satellites. Consequently, the Security Council can be the solution for an enforcement mechanism of space debris created through intentional destruction of satellites.

The deliberate destruction of satellites contributes to space debris or, to use the language of the Rescue Agreement,[23] space objects or component parts that are reasonably believed to be of hazardous or deleterious nature by a contracting party.[24] This will not make outer space sustainable in the long run, and the danger posed by space debris to manned and unmanned space missions cannot be overemphasized. Therefore, the determination that intentional destruction of satellites is a

[23] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, UNOOSA (1967), *entered into force* 3 December 1968.

[24] Ibid. art.5, para.4.

threat to peace will contribute significantly to efforts for the sustainable use of outer space. However, the only challenge that will be faced with such efforts is the fact that the key permanent members of the Security Council, namely, China, Russia and the United States, have the capability of antisatellite weapons. Thus, this will result in the permanent members to exercise the right to veto any effort to determine that deliberate destruction of satellites constitutes threat to peace. In such circumstances, the Security Council permanent members are not there to further the object and purpose, i.e. maintenance of international peace and security.

Therefore, the permanent members of the Security Council should put aside their individual interest and determine that intentional destruction of satellites is a threat to peace or breach of peace. Breach of peace in the sense that destroying satellites deliberately disturbs the peace that the international community enjoys which is contrary to the principle that the exploration and use of outer space should be done for peaceful purposes as enshrined in the Outer Space Treaty. The mere fact that a State destroys its own satellite is no justification because the consequences are dire, in particular the sustainability of outer space, let alone the huge danger posed or potential damage to be caused by the fragments of destroyed satellites. Such conduct should not be condoned by the Security Council because it will be grounds for justification for other States to carry out similar acts.

3.6 Conclusion

In conclusion, the Security Council has the primary responsibility of maintaining international peace and security. And the carrying out of activities in the exploration and use of outer should be done in the interest of maintaining international peace and security. Hence, intentional destruction of satellites is a threat to peace and is not within the interest of maintaining international peace and security.

The Outer Space Treaty's principle of peaceful exploration was formulated for the purpose of ensuring that armed conflict experienced at terrestrial level should not be expanded to the outer space. This is supported by partial demilitarization of outer space, in particular the prohibition of placing nuclear weapons or weapons of mass destruction in the orbit around the Earth, installing nuclear weapons and weapons of mass destruction or establishing and fortifying military bases on celestial bodies.

Consequently, the relation between the Outer Space Treaty and the UN Charter is that the former recognizes the primary object of maintaining international peace and security in the exploration and use of outer space that is main purpose (maintaining international peace and security) for which the international community established the United Nations. Thus, the international community realized the great threat posed to humanity or mankind if the terrestrial armed conflict was to escalate into outer space. Thus, the OST should or ought not to be inconsistent with the object and purpose of the UN Charter. As a result, the exploration and use of outer space should be for peaceful purposes; otherwise the use of outer space for

purposes other than peaceful ones will be contrary to international law, and in particular the Charter of the United Nations, and will not be in the interest of maintaining international peace and security. This is the overarching principle on which the United Nations was built.

In the final analysis, one of the challenges faced by the Outer Space Treaty is the lack of enforcement mechanisms for violations of treaty obligations. Therefore, the SC is the right platform to impose enforcement measures for violations of treaty obligations that are not in the interest of maintaining international peace and security. The very fact that the SC's primary responsibility is to maintain international peace and security, conferred to it by the Members of the United Nations, implies that there is no institution better placed than the SC to impose enforcement measures in instances where the exploration and use of outer space is not in the interest of maintaining international peace and security. Furthermore, the SC has before exercised its discretion to determine several situations as a threat to peace or breach of peace, and it imposed economic sanctions for threat to peace or breach of peace. Therefore, it is the best option to decide that intentional destruction of satellites is a threat to peace or breach of peace. And such conduct is neither in the interest of maintaining international peace and security nor does it amount to peaceful exploration and use of the moon and celestial bodies as required by the Outer Space Treaty.

Chapter 4
Peacekeeping Operations in Outer Space: Contradictions in Article IV of the Outer Space Treaty

Eduardo Bressel Baratto

Abstract All the States Parties to the Outer Space Treaty recognize the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes. However, let us imagine a futuristic scenario where terrorists or tyrants had access to space and began to unleash terror in a space colony. What would be possible to do from a legal point of view?

Peacekeeping has proven to be one of the most effective tools available to the UN on Earth to maintain peace and security in those countries where peace is far from being achieved. But will it also be a useful tool in outer space? The fact is that the current text of Article IV of the Outer Space Treaty prevents such operations through a series of contradictions within its content.

4.1 Introduction

The Outer Space Treaty is without any doubt the cornerstone of research and space exploration. It is the tree from which the different UN space treaties emanate as if they were branches. It establishes the principles by which all space activities, either governmental or private, should be governed.

It is a treaty that has as many sympathizers as detractors. There are those who believe that it is an old, obsolete and completely outdated treaty to the current reality. But, is it necessary to update a 50-year-old treaty? The truth is that the growth of the space industry is unprecedented. Each year the development of new technology allows us to reach goals that were unthinkable for the human being. Fifty years ago, we looked at the Moon as the last frontier; now we are looking forward to finding life on Mars. Where will we be in the next 50 years?

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A. Froehlich (ed.), *A Fresh View on the Outer Space Treaty*, Studies in Space Policy 13, https://doi.org/10.1007/978-3-319-70434-0_4

On the one hand, I believe the Outer Space Treaty has a solid base. It establishes very well-defined principles, which allows a magnificent international cooperation between nations for the exploration of space. In addition, I would say that it is a visionary treaty, which looks towards the future.

On the other hand, regulations and treaties should be updated to new realities. The human being undergoes many changes in the different stages of their life. Most of these changes are products of external agents of the society in which they live. Consumerisms, technology, new trends and trade, among others, affect the individual, directly or indirectly, forcing them constantly to change. *According to Darwin's Origin of Species, it is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able best to adapt and adjust to the changing environment in which it finds itself.*[1] In the same way that the human being has to adapt to social changes, the law must as well.

However, this is not so simple. A treaty may be amended by the agreement of the Parties. Every Party to a treaty is entitled to participate in the amendment's negotiations and to become a Party to the new amendment. Parties are not required to adopt amendments. In fact, in accordance with the Vienna Convention on the Law of Treaties (part IV), the pre-amendment terms remain binding for any Party that does not adopt the amendment, even in dealings with a Party that is bound by the amendment.

Nevertheless, it is true that there are several points in the Outer Space Treaty that could be adapted to the new economic, industrial and social reality in which we live. In this analysis, the focus will be on the possibility of carrying out *peacekeeping operations* for the maintenance of peace and security in outer space.

4.2 Peaceful Purposes in Outer Space

As it is well known, one of the general principles which must be present in all space activities is that the use and exploration of outer space shall be for the benefit of all countries and shall be in accordance with international law, including the Charter of the United Nations, with the interest of maintaining international peace and security.[2] Everything that has to do with peace and international security is more than welcome, but do we know what it means to maintain international peace? And, what do we mean by security?

In the field of law, every concept has to be defined and differentiated. In the world of criminal law, it is very important to distinguish between murder and homicide, rape and sexual aggression and kidnapping and unlawful detention. In space law it should not be any different. All concepts would have to be defined for a better

[1] Leon C. Megginson, "Lessons from Europe for American Business" [1963] The Southwestern Social Science Quarterly, 4.

[2] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies 1967 Article 3 (1).

understanding of the treaties. For example a proper definition of the concept "Space Object" would solve many legal doubts, e.g. the legal framework of suborbital flights and the legal framework for the launch of satellites with unmanned free balloons, since these are considered aircrafts according to the Chicago Convention, and therefore Air Law must be applied in those activities that are carried out with balloons.

All the States Parties to the Outer Space Treaty recognize the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes. Nevertheless, the concept "peaceful purposes" could have many meanings. We could understand "peaceful" as devoid of violence or force[3] or not willing to take part in war or violence.[4] And "purpose" could be understood as the reason for which something exists or is done. Therefore, "peaceful purposes" could mean that all the actions that are carried out must be done without the use of violence or force. The term "force" is frequently associated with something bad and cruel, but the truth is that peace and force hardly ever exist without each other.

However, not all the nations in the world share the same concept of "peaceful". There are countries where peace is not known, let alone security, places where the evil of the human being is the model of government. To assist those countries where peace is far from being achieved, peacekeeping has proven to be one of the most effective tools available to the UN.[5] The UN Charter gives the Security Council primary responsibility for the maintenance of international peace and security.[6] This responsibility is not only applicable on the planet Earth, but it also has application to be extended to all places where the human being is, e.g. the Moon, Mars, etc.

In fulfilling this responsibility for the maintenance of international peace and security, the Council can establish a UN peacekeeping operation.[7]

4.3 United Nations Peacekeeping

United Nations peacekeeping began in 1948 when the Security Council authorized the deployment of UN military observers to the Middle East.[8] Since then 69 peacekeeping operations have been deployed by the UN, 56 of them since 1988. Over the years, hundreds of thousands of military personnel, as well as tens of thousands of

[3] "Merriam-Webster" (n.d.) https://www.merriam-webster.com/dictionary/peaceful. Accessed 16 June 2017.

[4] "Macmillan Dictionary" (n.d.) http://www.macmillandictionary.com/dictionary/british/violence. Accessed 16 June 2017.

[5] UN Peacekeeping, http://www.un.org/en/peacekeeping/operations/peacekeeping.shtml

[6] Charter of the United Nations 1945 s Chapter 5 (Article 24)(1).

[7] 'Mandates and the legal basis for peacekeeping' (United Nations Peacekeeping) http://www.un.org/en/peacekeeping/operations/pkmandates.shtml. Accessed 1 July 2017.

[8] "History of peacekeeping" (United Nations Peacekeeping) http://www.un.org/en/peacekeeping/operations/history.shtml. Accessed 1 July 2017.

UN police and other civilians from more than 120 countries, have participated in UN peacekeeping operations. More than 3326 UN peacekeepers from some 120 countries have died while serving under the UN flag.

In theory, these missions to maintain peace must not be enforcement operations. However, the United Nations itself recognizes that situations can arise where the use of military force is necessary.

Peacekeeping operations are aimed at preserving peace in contexts of tension, for instance, in countries where the war has already ended by signing a peace agreement and conditions established therein. These operations require the consent of the parties and use force only in self-defence.

However, it is impossible to maintain peace where it does not exist. Therefore, there are other types of missions whose purpose is the establishment or imposition of peace. These are peacemaking operations and peace-enforcement operations.

In the first place, peacemaking operations have the objective of pacifying an unstable situation and getting the parties to reach a global agreement by peaceful means. Its paradigm was the United Nations operation in Namibia in 1989–1990, having subsequently conducted similar operations in El Salvador, Angola, Cambodia and Mozambique.

Secondly, peace-enforcement operations do not have the consent of the State in which they operate and contemplate the active use of force to impose a certain mandate of the Security Council, such as the cases of UNOSOM II[9] and UNPROFOR,[10] for instance.

Even though these operations are not carried out in the same way, all of them are carried out with the aim of achieving peace. Therefore, they should be considered as "peaceful purposes".

As we can see, there are situations where "peaceful purposes" may include the use of force and therefore the use of an army. Article IV of the Outer Space Treaty states that States Parties to the Treaty must not undertake to make use of nuclear weapons or weapons of mass destruction. The installations of military bases, fortifications or any type of military manoeuvre in a celestial body are also forbidden.

After reading the content of this article, a question comes to mind: How will it be legally possible to carry out peacekeeping operations in which the use of military force is necessary in outer space, if it is not possible to install military bases and carry out military manoeuvres to deal with those countries that choose not to respect the resolutions of the United Nations?

[9] United Nations Operation in Somalia II.

[10] United Nations Protection Force in Croatia and in Bosnia and Herzegovina during the Yugoslav Wars.

4.4 United Nations Peacekeeping Operations in Outer Space

Even though colonization of space has not begun, it may be necessary at some point to carry out peacekeeping missions in outer space.

The fact is that the United Nations already foresaw this scenario, including a small phrase that may go unnoticed in Article IV of the Outer Space Treaty: "The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited". This Article IV is a clear sign of the futurist vision that this treaty has.

With this in mind, it seems peacekeeping operations could be utilized in outer space. Right now, access to outer space for civilians is quite difficult and expensive. But this fact is changing, since the development of technology and cost reduction in rocket launches will allow us to have the first colonies along our solar system in less than 100 years. Now, let's imagine a futuristic scenario where terrorists or tyrants had access to space and began to unleash terror in one of these colonies. What would be possible to do from a legal point of view?

To carry out a peacekeeping operation in outer space would be legally difficult. The reason why is because, when analysing Article IV in depth, there are three contradictions in its content. On the one hand, this article allows the use of military personnel for peaceful or scientific uses. On the other hand, the use of nuclear weapons and weapons of mass destruction, as well as the installation of military bases and fortifications, and the military manoeuvres are totally prohibited. To explain this contradiction, it is necessary to analyse point by point the prohibitions found in this article.

4.5 Article IV Prohibitions

Within the content of Article IV, two different prohibitions can be found. The first prohibition applies to the installation of nuclear weapons and weapons of mass destruction. The second one prohibits the establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies.

The main objective of Article IV is to partially avoid the militarization of space, partially because it only prohibits the installation of nuclear weapons and weapons of mass destruction, leaving unregulated antisatellite weapons (ASAT), already used by the United States and China, or any other type of weapon that cannot be classified in the two categories mentioned. Saying that outer space is only used for peaceful purposes and for the good of mankind is to obviate reality. Outer space supposes a completely revolutionary advance in military matter. It allows to observe, to listen and to direct the movements of the military forces. Having "spy" satellites is a strategic advantage over the enemy. The concept of war has completely changed. The objective is no longer to take the territory of the enemy but to strike precise

blows in its weak points. Space war is not an idea, but it is a reality. General John E. Hyten, US commander of Air Force Space Command, said: "We have to deter bad behaviour in space and we have to deter conflict in space",[11] referring to China and Russia as potential troublemakers. General Hyten claimed that "in the not-so-distant future" Moscow and Beijing will be able to threaten every spacecraft the United States has in space. "We have to prevent that", Hyten said, "and the best way to prevent war is to be prepared for war. So the United States is going to do that, and we're going to make sure that everybody knows we're prepared for war".

4.5.1 Nuclear Weapons and Weapons of Mass Destruction

The prohibition of nuclear weapons and weapons of mass destruction does not warrant attention in this analysis since they will never be used in peacekeeping missions. It is true however that following some national regulations, for example, United States regulation, we could say that weapons of mass destruction have been used previously in some UN peacekeeping operations.

The US regulation defines these weapons as[12] "any destructive device as defined in Section 921; any weapon that is designed or intended to cause death or serious bodily injury through the release, dissemination, or impact of toxic or poisonous chemicals, or their precursors; any weapon involving a biological agent, toxin, or vector; or any weapon that is designed to release radiation or radioactivity at a level dangerous to human life".

The already mentioned Section 921 also includes bombs as weapons of mass destruction. It appears that during the peacekeeping operation in the Congo, from 1960 to 1964, the UN made use of Indian bombers to destroy airfields used by mercenaries.[13] According to US legislation, this attack with bombers could be considered as an attack with weapons of mass destruction. Nevertheless, this is a bit tricky since other UN countries have other conceptions about this weaponry.

Unfortunately, we live in a world that requires weapons to guarantee peace and security. Moreover, in our world, peace can be maintained by inspiring fear in the mind of the adversary. The point is to inflict so much fear on the other side that they will either give in or resist from taking the first shot.[14] That is the reason why some nations decided to start with nuclear programmes. It is hard to say, but the existence

[11] Cheryl Pellerin, "Hyten: Deterrence in Space Means No War Will be Fought There" [2017] Department of Defense, DoD News, Defense Media Activity https://www.defense.gov/News/Article/Article/1061833/hyten-deterrence-in-space-means-no-war-will-be-fought-there/. Accessed 3 July 2017.

[12] According to U.S. Code, Title 18, Part I, Chapter 113B, §2332a – Use of weapons of mass destruction (WMD).

[13] A. Walter Dorn, *Air Power in UN Operations: Wings for Peace* (Ashgate Publishing, New York) 1.

[14] Debájit Sarkar, Subject Matter Expert – Smart Weapons & Unmanned Vehicle Systems.

of nuclear weapons could be the reason why we are not having a third world war as they create a geopolitical equilibrium, which may not bring peace, but stability.

4.5.2 Establishment of Military Bases in Outer Space

Following with the analysis of Article IV, we are faced with the second prohibition: "The establishment of military bases, installations and fortifications, …. shall be forbidden".

According to the UN, peacekeeping operations are rarely limited to one type of activity.[15] While deployed in the context of a political framework supporting a peace agreement or in the context of creating the conditions for a return to stability, peacekeeping missions may require the use of force, particularly in situations where the host State is unable to provide security and maintain public order.

To meet these complex peacekeeping challenges, military components often play a pivotal role in providing and maintaining a secure environment. Under these circumstances, the deployment of a UN Force Headquarters Support Unit can contribute decisively by providing security and essential administrative support to the Force Headquarters and military installations. The establishment of a headquarters (HQ) or an operations centre is essential for the success of the mission. From there, the planning of the operations and the logistical support is carried out.

Some examples of headquarters in UN missions could be the headquarters in Juba, South Sudan, for UNMISS[16] operation, and the headquarters in Kinshasa, Democratic Republic of the Congo (DRC), for MONUSCO[17] operation. The mission views the DRC as consisting of six sectors, each with its own staff headquarters; the Blue Beret Camp, on the Mediterranean island of Cyprus, is a base camp and headquarters located on the west side of the city of Nicosia, which forms the headquarters of the UNFICYP.[18]

These examples denote the need to establish military installations, whether they are headquarters or advanced quarters to carry out patrols, etc. This need clashes with the prohibition contained in Article IV of the Outer Space Treaty. Therefore, there is a contradiction as it is possible to use military personnel for peaceful purposes, but military bases cannot be established in outer space.

[15] United Nations Peacekeeping Operations Principles and Guidelines 2008s 2 (2.2)(1).

[16] United Nations Mission in the Republic of South Sudan.

[17] United Nations Organization Stabilization Mission in the Democratic Republic of the Congo.

[18] United Nations Peacekeeping Force in Cyprus.

4.5.3 Military Manoeuvres in Outer Space

Last but not least is the prohibition of carrying out military manoeuvres: According to Article IV, "the conduct of military manoeuvres on celestial bodies shall be forbidden". First we need to understand the concept of military manoeuvres to see how it is being contradicted.

A good example is how Malaysian law defines this concept. A military manoeuvre means "any deployment of service personnel, guns, vehicles, ships or aircraft carried out on any land, sea, tidal water, shore or air by the armed forces or any of the visiting forces".[19]

Curiously, Article 42 of Chapter VII of the Charter of the United Nations contemplates the need to carry out military manoeuvres: "Should the Security Council consider that measures provided for in Article 41 would be inadequate or have proved to be inadequate, it may take such action by air, sea, or land forces as may be necessary to maintain or restore international peace and security. Such action may include demonstrations, blockade, and other operations by air, sea, or land forces of Members of the United Nations".

Here again we find the same contradiction as mentioned in the previous section, since the use of military personnel will be permitted for peaceful purposes in outer space, but military manoeuvres will not be allowed. Even though military personnel are used only for peaceful purposes in outer space, a military manoeuvre is indeed necessary to deploy such personnel.

The content of Article IV is not completely wrong, but needs to be rephrased. Below I propose an updated text for Article IV, which includes the possibility of establishing military bases and carrying out military manoeuvres, as long as the UN Security Council authorizes it.

4.6 Conclusion

For the time being, international cooperation and peace prevail in outer space. Nations cooperate in its exploration and use. But, will it continue to be so in the future? We have not even begun to make use of all its applications. What will happen when nations begin with space mining or with the establishment of colonies along the solar system? In that case the problem will not be who arrives first, but who arrives second. Will the nations be willing to share the resources with a newcomer?

This does not mean we should disagree with the use of space with a lucrative spirit, including the extraction of natural resources. But we should not turn our backs on reality, and the truth is that the extraction of natural resources has triggered conflicts throughout the history of mankind. For the last 60 years, over 40% of civil

[19] Military Manoeuvres Act 1983s Act 295 (1).

conflicts have been connected with natural resources.[20] What is currently happening in the South China Sea is a clear example of conflict in connection with the extraction of natural resources. Natural resources are a very important source of national income for many countries. In addition, if they are used effectively, they can provide jobs, infrastructure and livelihoods to local populations. Space mining could be, in the not-so-distant future, a source of conflicts between space actors.

Article IV is a really good attempt to achieve peace and stability in outer space. The prohibition of using weapons of mass destruction and nuclear weapons is, without any reasonable doubt, necessary and non-negotiable. However, the installation of military bases and military manoeuvres could be necessary, since the more space actors there are, the more possibilities of conflict exist. It is necessary to understand that space has ceased to be a place of exclusive actions for nations and space agencies. The private sector has arrived and is striking very hard with projects of great proportions.

The ultimate goal of this analysis is to seek improvement of the Outer Space Treaty; it is useless to criticize if solutions are not provided. Therefore, here is a proposed updated text for Article IV which contemplates the possibility of establishing military bases and carrying out military manoeuvres, as long as it is authorized by the United Nations Security Council:

States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The testing of any type of weapons shall also be forbidden.

The establishment of military bases, installations and fortifications, and the conduct of military manoeuvres on celestial bodies for peaceful purposes shall be prohibited, unless it is authorised by the United Nations Security Council.

The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited.

The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited.

In this way, the original prohibitions would be maintained, but the door would be left open to possible peacekeeping operations in outer space, in case they were needed. As John F. Kennedy said, “Change is the law of life. And those who look only to the past or present are certain to miss the future”. If we wait for something to happen to start regulating it, we will always be late.

[20] United Nations Environment Programme, “Addressing the Role of Natural Resources in Conflict and Peacebuilding” [2015].

Chapter 5
Wild Military Operations in Outer Space: A Sword of Damocles Hanging over the Future of Space Environment and Space Activities

Matteo Frigoli

Abstract This analysis will discuss the way in which the Outer Space Treaty faces the contemporary challenges of the expansion of militarization of outer space. Military and geopolitical reasons seem to freely dominate the outer space dimension. An examination of the relevant issues of the contemporary scenario is given before analyzing the legal framework in place. The Outer Space Treaty was drafted for the purpose of proscribing norms to an area that was without law. This legal regime was destined to confront the evolution of outer space technology especially in the military field. This assumption contains the premise of the proposal to reassess the nature of the Outer Space Treaty as a ductile legal framework and to set out a hierarchy based on the interpretation of Article IX of the Treaty.

5.1 Space Technology Progress: Expanding Sinkhole in Outer Space Treaty

The Outer Space Treaty[1] is the basic legal framework of international space law, providing also the most relevant regulatory regime as far as the military utilization of outer space is concerned. It has been considered as a quasi-constitutional treaty.[2] According to Robinson and White, in fact "[the Outer Space Treaty] is a quasi-constitution, not only culmination, but also an initiation."[3] The principles it contains are indeed the foundation of the Liability Convention, the Registration Convention,

[1] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 610 UNTS 205 (Outer Space Treaty).

[2] J. I. Gabrynowicz, "The Outer Space Treaty and enhancing space security," UNIDIR, Building the Architecture for Sustainable Space Security: Conference Report 30–31 March 2006.

[3] George S. Robinson, Harold M. White, *Envoys of Mankind: A Declaration of First Principles for the Governance of Space Societies* (Smithsonian Institution Press, 1986) at 181.

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A. Froehlich (ed.), *A Fresh View on the Outer Space Treaty*, Studies in Space Policy 13, https://doi.org/10.1007/978-3-319-70434-0_5

and the Astronaut Rescue Agreement.[4] Although the intent of this research is much more limited than an analysis of the Outer Space Treaty, it relates to the fundamental assumption that space represents the apogee of what combat commanders have sought for centuries: "the high ground."[5] But at the same time, it represents a key factor for scientific and economic development, affecting the standards of living of the individuals. In this context, the norms of the Outer Space Treaty will be confronted with the essential premise that "wild" military operations in outer space could be a definitive threat to future space activities, making outer space similar to a "toxic" environment.

With this purpose in mind, this analysis will first take into account:

1. The fast evolution of space-related technology
2. The underlying issue that outer space has always been militarized and this process is not reversible[6]
3. The unbounded prominence of military outer space activities

5.1.1 Fast Evolution and Articulation of Space-Related Technology

This aspect is particularly relevant because it affects the other two circumstances mentioned above. As a result of the increased accessibility of space technology, space assets and space actors have deeply diversified. In the 1960s, when the Outer Space Treaty was drafted, the only effective space actors were the United States of America (USA) and the Union of Soviet Socialist Republics (USSR). In the 1980s, building and launching a satellite was the remit of a few developed countries with massive industrial capabilities. Nowadays, many more countries and private companies are engaged in space-related activities, a trend that is expected to further develop in the coming years.[7] Though, the regulatory regime of outer space has not kept the pace with the underneath evolution of space technology.

Nowadays, everyday life would be unthinkable without reliable satellites orbiting in space. Phones, personal data devices, radios, and televisions, in one way or another, rely on satellites for the transmission of the information that flows to and from them. Most of air, sea, and land vehicles use the Global Positioning System (GPS) for precise location and navigation. Weather forecasters would be

[4] Gabrynowicz (n.2).

[5] M. N. Schmitt, *International Law and Military Operations in Space*, in A. von Bogdandy, R. Wolfrum (eds.) *Max Planck Yearbook of United Nations Law* (vol. 10, 2006, Brill Academic Publishers).

[6] Anél Ferreira-Snyman "Selected Legal Challenges Relating to the Military Use of Outer Space, with Specific Reference to Article IV of the Outer Space Treaty" (2015) 18(3) POTCHEFSTROOM ELEC. L.J. 488; Johannes M. Wolff "'Peaceful uses' of outer space has permitted its militarization: does it also mean its weaponization?" (2003) Disarmament Forum 5.

[7] oecd, *The Space Economy at a Glance 2014* (2014, oecd publishing).

compromised without satellite's information, and the same is true for international money transactions.

Moreover, most of space assets, such as communications, observation, and surveillance satellites, may be exploited for both military and non-military purposes. As it will be better discussed, dual-use capacity poses hard challenges in regulating military uses of outer space, since civilian and military assets have become increasingly intertwined and therefore any attempt to prohibit military uses of outer space would be futile.

5.1.2 Outer Space Has Always Been a Militarized Environment

Outer space became a matter of national security since the launch of the first satellite. Military and strategic considerations have been – and will continue to be – the main reasons why states access outer space. As it has been correctly observed: "Space has always been militarized. Military considerations were at the heart of the original efforts to enter space and have remained so to the present day."[8] Due to its unique features, outer space offers crucial advantages to war fighters; for example, it offers persistency of coverage, space objects move at extremely high speed because of orbital mechanics, and there is no point in the earth's surface or in the airspace which cannot be observed from outer space.[9] During the Cold War, the USA and the USSR invested huge resources in their respective space programs, causing the so-called space race in which the space arms race involved both the evolution of space-asset capabilities and of the technology to destroy or deny those capabilities through antisatellite weapons (ASAT). In this last regard, from now on, it should be clear what is meant by "militarization" and "weaponization" of outer space.

The militarization of outer space may be described as the passive military use of outer space. This includes activities in which satellites are not part of a direct engagement in warfare, playing a non-aggressive role with an indirect military value. For example, satellite positioning, reconnaissance, or surveillance systems are traditionally considered a passive military use of outer space.

On the other side, weaponization of outer space regards activities in which space assets are part of a direct engagement in warfare, described as "the deployment of weapons of an offensive nature in outer space or on the ground with their intended target located in space."[10] The weaponization of space through antisatellite weapons represents a growing threat and the simplest way to make outer space a battlefield, making the idea of space warfare day by day more real.

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[8] Ferreira-Snyman (n.6).

[9] Schmitt (n.5) at 94.

[10] Ferreira-Snyman (n.6) quoting Fabio Tronchetti "A Soft Law Approach to Prevent the Weaponisation of Outer Space" in Irmgard Marboe (ed.) *Soft Law in Outer Space: The Function of Non-binding Norms in International Space Law* (Böhlau Verlag 2012) 361–386.

In this scenario, dual-use capacity of space assets shall be concisely considered. Civilian and military space missions typically share launch pads, launch vehicles, space platforms, and satellites. The same technology could serve for military or civilian purposes, making a distinction impracticable. In fact, because of this dual-purpose approach, military and civilian space assets have become too intertwined to the point that a demilitarization of outer space could mean the impossibility to use outer space at all. For example, GPS systems can be used for civilian purposes but also to guide gravity bombs to targets.[11] This assumption leads also to the question if a dual-use satellite could be lawfully targeted by antisatellite weapons during a conflict, adding complexity to the matter.

Antisatellite weapons are particularly relevant both legally and factually since this technology is now relatively easy to achieve. Moreover, the effects of their utilization represent a vital danger for the outer space environment and for space activities. For a better understanding and due to the significance that ASAT weapons have in relation to the Outer Space Treaty and, more broadly, for the outer space environment, each type of these technologies will now be briefly canvassed.

Antisatellite weapons are primarily kinetic energy weapons, including standard missiles and co-orbital ASATs which rely on a physical object shot up from earth which either collides with the target satellite, destroying it via high-speed impact, or approaches it closely enough to blow up both itself and the target via a suicidal explosion.[12] The USA, the People's Republic of China, and Russia have all demonstrated military ASAT capability. Such capability is within the grasp of many other States, given the accessible nature of the technology underpinning the modified standard missiles used.[13]

Secondly, ASAT weapons are directed energy weapons. These technologies include, for example, an electromagnetic pulse (EMP), which is basically an electromagnetic shock wave, created by a nuclear explosion in space or by an electromagnetic bomb (E-BOMB),[14] a laser beam, a column of subatomic particles, radio-frequency transmissions, or a microwave generator. These devices could burn a fatal hole in the satellite's skin, temporarily or permanently blind its sensors, or possibly employ cyber warfare to alter the satellite's on-board computers, switching it off or even commandeering it for the attacker's own uses.[15]

[11] Earl D. Matthews "U.S. Space Systems: A Critical Strength and Vulnerability" (Ph.D. Diss., Newport, RI, Naval War College, 1996).

[12] David A. Koplow, "ASAT-isfaction: Customary International Law and the Regulation of Anti-Satellite Weapons, in Michigan Journal of International Law" (2009) 30(4) Michigan Journal of International Law 1187.

[13] Dale Stephens, Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare" (2015) 40 McGill Annals of Air and Space Law 1. Available at: https://ssrn.com/abstract=2722315.

[14] Ibid; Carlo Kopp, "The E-Bomb: a Weapon of Electrical Mass Destruction" Proceedings of InfoWarCon V, Washington, DC, September 1996.

[15] Koplow (n.12).

One major feature that distinguishes kinetic and directed energy ASATs is the creation of space debris.[16] The destructive effect of kinetic ASATs is achieved through the direct collision between the interceptor and the target, generating thousands of space debris destined to orbit around the earth at enormous velocities. Even small fragments could cause catastrophic damage.

This issue, as will be further discussed, constitutes an essential challenge both for the legal framework of Outer Space Treaty and, in a broader sense, for the future space activities.

5.1.3 Unbounded Prominence of Military Outer Space Activities

> The 21st century will prove to be the race for space. Space-based systems are the key enablers of national and international infrastructures of today and tomorrow. The current speed of technological developments indicates the pace of diffusion of technology with some form of dependence on space-related hardware will only accelerate. Accordingly, outer space is becoming increasingly congested, contested, and competitive.[17]

Almost every space-related technology has a high military value. As it was observed: "Space superiority is the future of warfare. We cannot win a war without controlling the high ground, and the high ground is space."[18] Space assets have proven their capabilities in warfare since the 1991 Gulf War, when communications, navigation, surveillance, and weather information were provided by satellites to national command authorities, providing a definitive advantage in the combat arena.[19] Space support acts as a force multiplier ensuring dominance in the battlefield.

But while, on the one hand, space systems become more integrated with the mechanisms of war, on the other hand, the essential space support turned out to be also a manifest weakness. Militaries with developed space capabilities have grown a strong reliance toward space assets in association with the awareness that during a conflict, the adversaries will try to deny their linkage to space.

This is even more relevant considering the vulnerability of space assets. In fact, satellites are "soft" targets. They are unshielded (even micrometeoroids could damage satellites due to orbital high speed),[20] and orbits are predictable which makes

[16] "Space debris is defined as all the inactive, manmade objects, including fragments, that are orbiting Earth or reentering the atmosphere" ESA, S*pace Operations-Space Debris: the ESA Approach* (March 2017, ESA Production).

[17] Nato parliamentary assembly "The space domain and allied defense" (Defense and Security Committee, Draft Report - 068 DSCFC 17 E, 20 March 2017).

[18] General L.W. Lord, "Space Superiority" (2005) 1 High frontier 3.

[19] Earl D. Matthews (n.11).

[20] "Micrometeoroids are somewhat of a hazard to spacecraft, although substantially less than once imagined. Meteoroid collision events have occurred, but rarely. The two highly probable known cases consist of geostationary spacecraft hit by small objects, probably meteoroids. In one case, the European Space Agency's Olympus satellite was lost as it consumed propellant in an attempt to

them easy to track. Moreover, they are still relatively few in number with the consequence that destroying or damaging even a handful of them could have a major impact. Finally, they are expensive and, accordingly, States and private corporations do not maintain standby fleets of spares to rapidly reconstitute a satellite architecture that was suddenly degraded by hostile action.[21]

Spacefaring nations have perceived the need to protect such a vulnerable and critical infrastructure. Renewed attention to ASATs by major spacefaring countries gave rise to military doctrines pursuing with different methods, the objective of outer space domination. For example, the US Air Force (USAF) categorizes space domination as "space superiority" that, through counterspace operations, aims at "ensur[ing] the freedom to operate in the space medium while denying the same to an adversary and, like air superiority, cannot be taken for granted."[22] China's army had already introduced the concept of "space force strength," apparently referring to the similar military concept conceived by the USA.[23]

As it has already been mentioned above, the USAF doctrine foresees defensive and offensive counterspace operations in order to deceive, disrupt, deny, degrade, or destroy adversary space capabilities.[24] It can only be a matter of time before other spacefaring countries will develop a same capability to conduct such operations in outer space. This evolving scenario could contribute to make the outer space a highly delicate "equilibrium." A coherent clue with this assumption could be the recent tests of a supposed space weapon by Russia (though a lot of secrecy surrounds these tests) and India's recent development of a layered missile defense system likely to have the capability (at least in the near-term) of direct-ascent ASAT capabilities.[25]

recover. A Japanese satellite sustained a hit in one solar array, with the only result being a minor loss of power generation capacity." M. D. Griffin, J. R. French *Space Vehicle Design* (2nd edn. American Institute of Aeronautics and Astronautics 2004) pp. 90–93.

[21] Koplow (n.12) at 1200.

[22] Defense Technical Information Centre, AIR FORCE DOCTRINE DOCUMENT 2–2.1: COUNTERSPACE OPERATIONS (2004) available at https://fas.org/irp/doddir/usaf/afdd2_2-1.pdf (last visited July 28, 2017).

[23] Steven Freeland, Jackson Maogoto, "Space weaponization and the United Nations Charter regime on force: a thick legal Fog or a receding Mist?" (2007) 41(4) The international Lawyer 1091.

[24] Defense Technical Information Centre (n.22) pp. 2–27.

[25] Nato parliamentary assembly (n.17) pp. 5–6.

5.2 How a 50-Year-Old Outer Space Treaty Can Avoid Today's Space Warfare: A Proposal

These three circumstances discussed above influence the Outer Space Treaty's legal regime, rendering the regulation of military uses of outer space an extremely arduous task.

Article IV of the Treaty specifically deals with military activities in outer space, contains a "peaceful purposes" clause, and establishes a partial demilitarization of outer space. It indeed provides that:

> States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited.[26]

Notably, State parties to the Treaty are forbidden to place in orbit around the earth any nuclear weapons or any other weapon of mass destruction or station such weapon in outer space in any manner. The placement in outer space of any other kind of weapons, such as antisatellite weapons, or the transit of antiballistic missiles and any other kind of rockets through space is not forbidden.[27] The "peaceful purposes" clause lacks thus of specificity. However, in the debate between "non-military" and "non-aggressive" significance of this provision, the "non-aggressive" use of outer space has prevailed.

During the negotiation of the Outer Space Treaty, the space powers were extremely careful in ensuring that no provision of the Treaty could infringe on their plans to allow for limited military uses of outer space, such as permitting intercontinental ballistic missiles to have part of their trajectory in outer space. Other limited uses included the so-called "support activities" or passive military uses, through satellites reconnaissance, navigation, and surveillance.[28] The passive military use of outer space has been accepted by the international community, based on the perceived non-aggressive nature of these activities. Such activities are indeed accepted as legal by the large majority of States and thus as not contrary to Article 2(4) of the United Nations Charter.[29] That said, military uses of outer space which are in fact

[26] Art. IV Outer Space Treaty (n.1).

[27] Fabio tronchetti, *Fundamentals of Space Law and Policy* (Springer, 2013) at 9.

[28] Detlew Wolter, *Common Security in Outer Space and International Law* (UNIDIR 2005) [emphasis added].

[29] Art.2(4) of the United Nations Charter provides as follows: "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations." United Nations, *Charter of the United Nations*, 24 October 1945, 1 UNTS XVI.

not really peaceful (such as the use of satellites to direct bombing raids) are also currently accepted by States.[30] Actually, it seems that spacefaring States are changing their course progressively toward "space weaponization."

As it has been discussed above, the militaries of space States increasingly rely on space assets, and the armed conflicts of the twenty-first century and beyond will increasingly involve the utilization of outer space.[31]

On 11 January 2007, the Chinese military launched an ASAT ballistic missile against one of its aging weather satellites of the Fengyun series. The move was widely condemned by other States. But it must be noted that the official statement of other States rarely raised any objection under international law. As a matter of example, a spokesperson for the UK was reported to have said: "We are concerned about the impact of debris in space and we expressed that concern […] We don't believe that this does contravene international law."[32]

The lack of legal clarity and good faith by space powers allowed military and geopolitical interests to fill the legal gaps of the Outer Space Treaty. In this context, considering the practice of States, it seems that an aggressive use of space (e.g., through ASAT deployment) has evolved from unlawful to unfriendly, putting the outer space environment in an extremely delicate state. There are currently 1459 satellites and millions of space debris orbiting around the earth.[33] Estimating a growth in the population of space objects, it could be argued that outer space is a progressively crowded environment likely to be endangered from an unbound utilization.

The interrelation between this circumstance and Article IX of the Outer Space Treaty is particularly relevant.

The first sentence provides that in the use and exploration of outer space "States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance." The second sentence significantly points out that "States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth" and adopt measures for this purpose. The third sentence contains a mandatory international consultation clause in that if a "State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties" or "a State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful

[30] Ferreira-Snyman (n.6).

[31] Steven freeland, "In Heaven as on Earth? The International Law Regulation of the Military Use of Outer Space" (2011) 8 US-CHINA LAW REVIEW 272.

[32] Freeland, Maogoto (n.23); Pavle Kilibarda "The Militarization of Outer Space and Liability Convention" (2015) 40 (3) 271.

[33] UCS Satellite database available at http://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.WX4KsoSGPIU (last checked 29 July 2017).

interference with activities in the peaceful exploration and use of outer space," then a State "may request consultation concerning the activity or experiment."

Leaving aside the fact that the Treaty neither proscribes the procedure for appropriate international consultations nor designates an agency with this function, a broad interpretation of Article IX could be very significant in the regulation of outer space activities.

"Harmful contamination of the outer space" and "harmful interference with outer space activities of other state-parties" are supposed to be avoided in pursuing studies and exploration of outer space. In fact, a persistent contamination of outer space would harm the whole community of spacefaring States if not the entire global community. One of the major sources of outer space contamination is space debris.

In effect, space debris is one of the most challenging issues for outer space activities: an unrestrained growth in the population of space debris could indeed lead to deny the future access to outer space to States that pursue this objective and even to States that currently exploit outer space.

There are currently 29,000 objects larger than 10 cm, 750,000 objects from 1 cm to 10 cm, and 166 million objects from 1 mm to 1 cm orbiting the Earth.[34]

Looking at the contemporary scenario, it can be sustained that the obligation of "no harmful contamination of outer space" and "no harmful interference with outer space activities of other state-parties" has progressively assumed, through the evolution of space technology, a high value in the legal framework of the Outer Space Treaty.

With the state practice directed toward the threshold of weaponization and a growing population of space debris, Article IX should be considered the core of the future regulation of outer space activities.

In fact, it could be argued that the threat perceived by States does not come from the passive or active military use of outer space itself. Instead, the real threat perceived by States seems to rest in the creation of space debris. Debris from an ASAT test or attack would generate thousands of these random fragments, dispersed into a lethal orbiting cloud and destined to remain aloft for years, decades, or even centuries, especially in high-altitude orbits.[35]

With respect to Article IX, outer space activities shall firstly be in accordance with the obligations of "no harmful contamination of outer space" and of "no harmful interference with outer space activities of other state-parties," regarded as an inalienable condition of outer space exploitation itself. This circumstance shall have a particular significance with respect to the nature of military activities in outer space carried out by State parties, which should be aligned firstly with Article IX, seen as a fundamental threshold of lawfulness of each space activity.

This "case-by-case" approach does not exclude military uses of outer space or an evolution of the same if aligned with the obligation of Article IX.

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[34] ESA, "Space debris by the numbers" available at http://www.esa.int/Our_Activities/Operations/Space_Debris/Space_debris_by_the_numbers

[35] Koplow (n.12) at 1203.

In fact, according to Article III of the Outer Space Treaty, space activities should be carried out in compliance with the international law and the United Nations Charter. Significantly, Article 51 of the UN charter is also applicable to the legal regulation of outer space, which confirms the "inherent right" of self-defense "if an armed attack occurs" even in outer space.[36] States will not give up their right of self-defense in outer space, especially since space assets have become an essential infrastructure. But this last assumption does not permit itself a "wild" militarization of outer space under the flag of the right of self-defense.

5.3 Final Remarks

The legal regime of Article IV has led to unconstrained military space operations increasingly oriented to the weaponization of outer space. This comes with the threat of an exponential growth of space debris, rendering outer space a potentially "toxic" environment.

The Outer Space Treaty shall be interpreted with a particular eye to the changing scenario which it refers. In this context, Article IX provides a precious legal framework suitable to face the contemporary and future challenges which have been analyzed above so to adapt the principles and rules of the Treaty to evolving outer space activities. As was quoted above, the Outer Space Treaty is also an "initiation."

International law shall respond proactively to the current issues, since with the increasing number of space actors and space-related interests, the thin factual and legal balance could break with unforeseen consequences.

[36] Freeland (n.31) at 277.

Chapter 6
Space Settlement and the Celestial Subjectivity Model: Shifting Our Legal Perspective of the Universe

Zach Miller

Abstract When considering the idea of human settlement of outer space, the discussion evolves from research stations and small outposts to large-scale habitats and complex societies. The current international legal regime does not account for the development of civilizations and sovereignty in outer space and on celestial bodies. The reason for this lies in the principle of conflict prevention that pervades the Outer Space Treaty. This principle, righteous as it may be, does not fit the modern world scene. In fact, the very definition of outer space is centered around the Earth, archaically symbolizing a geocentric legal perspective of the universe. To allow for human settlement of outer space and celestial bodies, international law must address the concepts of civilizations and sovereignty. This can be done by redefining the human perspective of outer space according to the celestial subjectivity model, in which outer space becomes "the space outside of a celestial body's gravity well relative to a state's presence and perspective on that particular celestial body." (Zach Miller, "On Celestial Subjectivity." *VAERO* (2016). Available at https://www.vaeroresearch.com/single-post/2016/09/26/On-Celestial-Self-Determination.) The implications of altering the definition of outer space are both concrete and abstract, ranging from more clearly allowing national research stations to ensuring the right of self-determination within a future civilization of Mars colonists.

6.1 Introduction

In *Sid Meier's Civilization: Beyond Earth*,[1] various entities travel from Earth to colonize an exoplanet. The purpose of the game is to compete for resources and power in order to grow the player's colony and defend it from other hostile colonies.

[1] *Sid Meier's Civilization: Beyond Earth*. Firaxis Games, 2014. Video game.

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Real-world mechanisms such as diplomacy, scientific research, and economics are embodied in a simulated system. The game can be won by a handful of methods, such as by dominating the other colonies militarily or by reaching a heightened level of scientific research for technological superiority. As the various colonies grow in size and strength, resources become scarcer; additionally, different colonies adapt conflicting ideologies, increasing global tensions. No matter what strategy a player pursues, and no matter how peaceful a player attempts to be, eventually war is inevitable. Diplomacy is the only method for resolving a conflict or reducing the costs of war. Essentially every game in the Civilization series consists of these basic concepts adapted to a different historical time period with different actors, but Civilization: Beyond Earth[2] is the only one projected into the future. This science-fiction simulation game inspires many questions for the future of space exploration, but the most important concept in the video game is the threat of war and conflict between space colonies. Even without losing wars, conflict in the game can prevent global progress toward scientific and cultural achievements. Fortunately, in the real world, laws exist to mitigate the threat of conflict in outer space, but how do these legal systems need to evolve in order to adapt to human settlement of outer space?

6.2 Concept of Human Settlement

Human settlement of outer space has yet to be seriously addressed in global discussions about the future of space law. One reason for this is that human settlement seems like a mere possibility in the distant future; perhaps the issue is not ripe for consideration. This argument has some relevance, as human settlement certainly does not incite any sense of urgency within the minds of lawmakers. However, good laws adapt to change, and the drafters of good laws integrate some degree of foresight in their decision-making. In considering changes to the space law regime, it would be wise to keep in mind the inevitable future of humanity's expansion into space – not just to visit but to stay. The concept of human settlement does not entail short-duration scientific voyages to and from Earth, nor does it entail small research bases our tourism centers on celestial bodies. Human settlement is the growth of a civilization in outer space; it is the presence of a society that is advanced to such a degree as to have developed a culture and a way of life in a particular area.[3] Human settlement is, put simply, people living life in outer space.

States are the primary actors in the use and exploration of outer space.[4] In modern times, the private sector has drastically increased its role in space exploration;

[2] *Id*.

[3] Andrew Targowski, "Towards a composite definition and classification of civilization." *Comparative Civilizations Review* 60, no. 60 (2009): 6.

[4] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies, 27 Jan. 1967, 610U.N.T.S. 205 [hereinafter "Outer Space Treaty"].

nonetheless, the fact remains that persons, companies, and organizations are inherently tied to the state. Regardless of whether or not the Outer Space Treaty was intended to account for private actors, states are still the building blocks of the international system, and historically, states tend to fight over resources and power. The Outer Space Treaty attempts to prevent conflict by disallowing national appropriation of outer space.[5] Without delving into the influence of the Cold War on the Outer Space Treaty, the general philosophy was similar to the approach used in the Antarctic Treaty: removing the possibility of claiming resources effectively removes the incentive for states to engage in conflict with one another.[6]

The Outer Space Treaty is an exemplary work of international law, and it has been largely successful in keeping outer space from becoming a direct theater of war. This may be in large part due to the appropriations provision in Article II. However, declaring appropriation of outer space as off-limits has very negative consequences for outer space as a domain for human civilization, as land rights are critical to human settlement of outer space. Without the ability of states to establish sovereign claims on extraterrestrial land, colonies in space can never be fully established. There are some counterarguments revolving around treaty interpretation, such as the ambiguity involving the complexities of defining sovereignty or the possibility of colonies being international scientific outposts. Nonetheless, it is undeniable that when the topic of human settlement arises, this domain of the Outer Space Treaty is at the very least unclear or, at most, fundamentally flawed.

Solving this issue is not as simple as removing the prohibition of national appropriation. The drafters of the Outer Space Treaty were correct in their philosophy that national competition yields national conflict. If national appropriation of outer space is permitted, then the possibility of conflict increases, and the peaceful use of outer space becomes threatened. The philosophical argument behind Article II of the Outer Space Treaty – and behind its predecessor, the Antarctic Treaty – is a good one that should be preserved as space law evolves and adapts to change. It seems that there is a contradiction at this intersection: human settlement of outer space is not possible without some degree of national appropriation, but prohibiting national appropriation is necessary for maintaining peaceful use of outer space. How, then, can the law provide for peace and human settlement simultaneously? The root cause of this problem is how outer space is interpreted from a legal standpoint; to solve it, there must be a change in humanity's legal perspective of the universe.

[5] *Id*., art. II.

[6] The Antarctic Treaty, Dec. 1959, 402 U.N.T.S. 71.

6.3 Legal Perspective of the Universe

6.3.1 Geocentric Model of Space Law

To understand this problem, it is necessary to consult the definitions of terms used in Article II. The language of the article reads as follows: "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[7] Outer space is defined in Merriam-Webster as the space immediately outside of the Earth's atmosphere.[8] The limit of outer space is perhaps customarily drawn at the Kármán line, 100 km above the Earth's surface.[9] A celestial body is vaguely defined as an aggregation of matter in the universe that constitutes a unit for astronomical study, such as planets or moons.[10] The common meaning of appropriation entails setting something aside for exclusive use, but the inclusion of "by any other means" leaves the definition of appropriation so broad that virtually any form of ownership meets the definition. Synthesizing these definitions, Article II can be summarized as saying that no nation may claim anybody of matter in the universe outside of the Earth's atmosphere. Article II therefore effectively prohibits national claims in outer space.

In many legal discussions of Article II, lawyers focus primarily on interpreting the meaning of appropriation.[11] However, "appropriation" is not the most essential term used in Article II; rather, the most fundamental piece of the Article's language is the term "outer space" and the following specifications regarding celestial bodies. Consider the change in language: "The Moon and other celestial bodies are not subject to national appropriation." Without using the term "outer space," Article II prohibits national appropriation anywhere, even on Earth. The inclusion of "outer space" therefore serves as a specification that Earth is the only celestial body exempt from the appropriation provision in the Outer Space Treaty. Analyzing the implications of the definition of outer space leads to the realization that Article II, the Outer Space Treaty, and the entire legal perspective of the universe are completely geocentric, with Earth as the center point of the legal universe.

Using the current definition of outer space, the planet Earth is not in outer space; Earth can be classified as "exospatial" or outside of outer space. Mars, being outside of the Earth's atmosphere, is therefore in outer space, as are Titan, Ceres, and Kepler-186f. If a viewer is standing on the surface of Mars and staring up at the pale blue dot of Earth, then the viewer is looking at the only point in the entire universe

[7] Outer Space Treaty, *supra* note 4, art. II.

[8] "Outer Space." *Merriam-Webster.com*. Accessed 30 July 2017. Available at https://www.merriam-webster.com/dictionary/outerspace.

[9] Francis Lyall and Paul B. Larson, *Space Law: A Treatise* (2013).

[10] "Celestial Body." *Merriam-Webster.com*. Accessed 30 July 2017. Available at https://www.merriam-webster.com/dictionary/celestialbody

[11] Stephen Gorove, "Interpreting Article II of the Outer Space Treaty." *Fordham L. Rev.* 37 (1968): 349.

that is not encompassed in the definition of outer space. In fact, even in the Martian gravity well, the viewer is standing in outer space. According to this perspective, if Mars is a celestial body, and if Mars is in outer space, then under Article II of the Outer Space Treaty, there can be no claims of sovereignty on the Red Planet, thus hampering the possibility of human settlement on Mars. This same chain of logic applies to virtually any area in the entire domain of outer space, including on any celestial body or in the vacuum of empty space. This rationale especially complicates national appropriation in other areas that are scarce or exclusive, such as Lagrangian points or geostationary orbits.[12] A solution must be unearthed that not only changes how the Outer Space Treaty is interpreted but also provides a mechanism that allows peaceful human settlement of outer space. This mechanism can be provided by redefining outer space.

6.3.2 Celestial Subjectivity Model of Space Law

Outer space can be redefined as "the space outside of a celestial body's gravity well relative to a state's presence and perspective on that particular celestial body." This is the model of celestial subjectivity, a paradigm shift in humanity's legal perspective of the universe. Under this definition of outer space, the essence of Article II changes to provide that no nation may claim anybody of matter in the universe outside of the gravity well of the celestial body on which that nation exists. This new rule accomplishes the same principle behind the original language used in Article II: preventing conflict between states by disallowing state competition for space resources. From the perspective of states on Earth, Mars is in outer space, but Earth is exospatial; to states on Earth, the universe is still geocentric. Earth states are free to compete for resources within the Earth's gravity well, including orbital trajectories. But to a state on Mars, Earth is in outer space, and Mars is exospatial; the universe to a Martian state is Mars-centric. This method adapts to any celestial body: to a state on Kepler-186f, Mars and Earth are both in outer space, but Kepler-186f is exospatial.

Notably, this definition does not mean that only the space between celestial bodies is outer space. This would mean that every celestial body is exospatial and therefore eligible for national appropriation. The celestial subjectivity model should be interpreted so that outer space is subjective: depending on the celestial location of a state, encompassing all celestial bodies outside of that state's planetary gravity well. In this way, celestial bodies become nexus points for the expansion of human civilization. One issue is that the definition of "celestial bodies" encompasses nearly every body of mass in the universe; under the new interpretation of Article II, asteroids and other space resources are likely off-limits for national appropriation. To avoid this, an exemption could be added to Article II that allows national appropriation of celestial bodies with characteristics such as minimal gravity wells, diminished capability to support human life, or great monetary value of the celestial body rela-

[12] Declaration of the First Meeting of the Equatorial Countries (Bogotá Declaration), 3 Dec. 1976.

tive to its settlement potential. This exemption would include most asteroids and comets, which would allow the space mining industry to flourish under a clearer framework of international obligations while also allowing human settlement of asteroids such as Ceres that do not fit into the exemption.

Moons are a very interesting category under the celestial subjectivity model. Though often they have relatively large gravity wells of their own, which would make them off-limits to national appropriation, moons are also within the overall gravity well of their parent planets, making them eligible for national appropriation. The exemption provided to certain asteroids does not fit well, as moons have established orbits around parent planets and are continuously in permanent proximity to planetary bodies. The decision, then, comes down to a matter of policy, and the best policy may be to allow moons to be eligible for national appropriation. Take, for example, our Moon, which can be referred to as Luna for purposes of clarity. This would permit the possibility of national stations, outposts, and settlements while still allowing for private facilities. Infrastructure on Luna has enormous benefits for exploring the rest of the solar system, particularly with the dawn of in-space manufacturing and fuel production on the lunar surface. The benefits of constructing facilities on Luna, even if undertaken only by a select few countries, will reach other countries with developing space programs by allowing for greater access to space, including Earth orbit, cislunar stations, and access to other planetary bodies.

However, other planets in the solar system host moons with drastically different characteristics than Luna. Titan, a moon of Saturn, consists of liquid methane oceans and a thick, nitrogen-rich atmosphere. Titan is even a candidate for harboring life of some kind, and its characteristics also make it more eligible for eventual human settlement than Luna. For Titan, the idea of having a habitable parent planet with non-habitable moons is reversed; Titan is a habitat-eligible moon with a non-habitable parent planet. As such, the law should be flexible to fit both scenarios. The exemption applied to asteroids and comets could also be applied to moons, rendering Luna eligible for national appropriation and Titan ineligible. This exemption allows for national appropriation of more resource-oriented moons and disallows national appropriation of more settlement-oriented moons.

There is one apparent contradiction within the celestial subjectivity model of outer space. If the underlying principle is to allow national appropriation, but national appropriation beyond a state's planetary gravity well is disallowed, then how can national appropriation occur? And if the premise is that national appropriation is necessary for human settlement, then how can human settlement occur without national appropriation? In terms of human settlement, how does the celestial subjectivity model actually change the effect of Article II? The celestial subjectivity model in Article II forbids a state from claiming sovereignty of another celestial body, just as does the original meaning of Article II. The United States cannot carve out a piece of territory, send hundreds of US citizens to a human settlement, and claim that the settlement is subject to the laws and authority of the United States. There is, however, a key difference that makes the celestial subjectivity model a much better definition of outer space for the purposes of human settlement.

6.3.3 The Free Mars Approach: Sovereignty, Civilizations, and National Appropriation

The difference revolves around the concept of sovereignty. Sovereignty is much more complicated and ill-defined than jurisdiction. Whereas jurisdiction simply implies the control of a sovereign government, sovereignty requires the embodiment of a people's will to be self-governed; it involves the right of self-determination, infused into some authoritative structure. More fundamentally, sovereignty requires a group of people with shared cultural values and social structures: sovereignty requires a civilization.

With modern attention being devoted to the idea of settling the Red Planet, Mars is a fitting case study for this analysis. A small research outpost established on Mars by the United States is not a sovereign claim – it is a jurisdictional claim. In fact, such jurisdiction is already provided for by the current regime of international law. Inversely, a large-scale human settlement on Mars with its own governmental hierarchy under the auspices of the United States is likely to be interpreted as a sovereign claim. This is what the current international legal regime does not provide for, and what the celestial subjectivity model would allow: the development of a civilization on another celestial body. At some point, because humanity's future in space is inevitable, a research outpost or small habitat will evolve into a civilization; at some point, a civilization will form, as opposed to an outpost of astronauts. The Outer Space Treaty must evolve to account for this. Under the celestial subjectivity model, the United States may establish a research station or scientific facility on Mars. But at some point, whenever a true civilization develops, whenever sovereignty is ripe for expression, the celestial subjectivity model prohibits the United States from retaining sovereign territory on Mars.

It is difficult, if not impossible, to draw a clear line at when this point will occur, but the dawn of a true civilization will likely involve self-sustainability and sovereign political expressions from the Martian people. Whenever the Martian society has sufficiently developed into what can be called a civilization, the celestial subjectivity model will prohibit the colonizing state from claiming sovereignty over the Martian civilization. A new state will be established on Mars, with sufficient governance to execute peaceful separation of the colony from the builder. In this way, the celestial subjectivity model allows for human settlement of another planet while prohibiting national colonization. Just by providing a new definition of outer space, the celestial subjectivity model allows for an entirely new method of colonization, oriented around habitable celestial bodies in which the presence of a civilization on a celestial body constitutes a sovereign entity, independent and free to act according to its own interests. This new form of colonization is focused on the expansion of life out into the solar system without sharply increasing the odds of conflict. To put this idea simply, once a civilization develops on a celestial body, a new sovereign state is created.

There are four fundamental characteristics of a state: population, territory, government, and sovereignty.[13] Any kind of Martian colony, including scientific outposts, will inevitably have the first three. The population consists of the astronauts or colonists, and with a larger population, the state of Mars becomes more tangible. Territory will exist in some form as well, whether as the buildings and infrastructure or as an area of land. The government will be present throughout the entire process, beginning with a professional hierarchy among Mars colonists and culminating in a governance model or regime. The last characteristic of a state that will arise on Mars is sovereignty, which emanates from the people.

There are various strategic benefits for having a sovereign Martian state.[14] Under the old concept of colonization in which a colony perpetually remains under the control of the colonizing state, the odds of conflict are much greater than with the new colonial framework provided for by the celestial subjectivity model. Because the end result of a sovereign state on Mars will be made clear from the beginning of the colonization process, states will not be competing for sovereign territory or permanent control of resources. Instead, colonizing states will hope to interact with the Martian state for Martian resources. The economic incentive for building human settlements on Mars persists under the new colonial model; the resources are still present, and states will still be able to acquire those resources. Instead of physically fighting over who gets to control the resources, states will compete peacefully for deals with the Martian state. This is a two-pronged scenario in which humans can settle another celestial body and Earth can gain access to the celestial body's resources. From a much more long-term perspective, having the plan for an independent Mars prepared ahead of time prevents the risk of revolutionary conflict once societies on Mars become self-sustaining.

6.4 Conclusion

The future envisioned under the celestial subjectivity model may seem like a world out of science fiction, but the reality is that human expansion into the solar system is inevitable. Even the Outer Space Treaty recognizes this in its attempt to prevent conflict by restricting permanent expansion into space. Now, half a century later, the world scene has changed, and a new era of human exploration of outer space has dawned. Redefining how we perceive the universe from a legal perspective is essential to the idea of humanity as a multiplanetary species. The universe is not geocentric; likewise, our legal perspective of it should not be geocentric. Instead, building toward human settlement of the solar system and beyond, the legal perspective of outer space should be centered around a core aspect of humanity itself: the human civilization.

[13] Andrew Coleman, "Determining the Legitimacy of Claims for Self-Determination: A Role for the International Court of Justice and the Use of Preconditions." *St Antony's International Review* 6, no. 1 (2010): 57–78.

[14] James Gilley, "The Case for Martian Independence." *The Strategy Bridge* (2016). See also Sarah Bruhns and Jacob Haqq-Misra, "A Pragmatic Approach to Sovereignty on Mars." *Space Policy*, vol. 38 (2016).

Chapter 7
Outer Space Treaty During Fourth Industrial Revolution

Maria Baczyńska-Wilkowska

Abstract The Outer Space Treaty was created 50 years ago. It contains the general rules of the exploration of outer space by human beings. Since the Outer Space Treaty entered into force, an enormous technological progress has been done. This study discusses how the Outer Space Treaty influences the rights and responsibilities of humans and robots in today's laws and how it might provoke changes to the Outer Space Treaty.

7.1 Introduction

The Outer Space Treaty was opened for signature and entered into force in 1967. Its creation was affected by the first human spaceflight in 1961 done by Yuri Gagarin on board Vostok 1. The Treaty was developed several years after the Second World War, and the use of weapons, including nuclear weapons, was still fresh. Both events affected the Treaty where the respect for cosmonauts and a danger of weapons were clearly visible.

During the last 50 years, social, economical, and technological conditions of mankind have dramatically changed. Nowadays we are at the beginning of the Fourth Industrial Revolution (Industry 4.0).[1] It is the time where the barrier between human and machine disappears and the time where the internet of people, internet of things, internet of services, and internet of data communicate with each other. Cyber-physical systems control physical processes, create virtual copies of a real world, and undertake decentralized decisions.[2] The process leads to growing popularity of autonomous robots, which are more and more powerful and present

[1] The term Industry 4.0 (originally Industrie 4.0) comes from a high-tech strategy project of the German government. It was presented for the first time in 2011 at the Hannover Fair.

[2] Definition of the Fourth Industrial Revolution given in 2016 by Mario Hermann, Tobias Pentek, and Boris Otto in their paper "Design Principles for Industrie 4.0 Scenarios."

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A. Froehlich (ed.), *A Fresh View on the Outer Space Treaty*, Studies in Space Policy 13, https://doi.org/10.1007/978-3-319-70434-0_7

in the majority of areas of today's life. Being popular on Earth, they will soon be popular in space.

The Outer Space Treaty was created when humans were the only known beings capable of making decisions in space, performing an exploration and use of space. Soon there will be, or perhaps already exist (dependent of the established definitions), autonomous machines ready for exploration of celestial bodies. The current version of the Outer Space Treaty does not cover all cases of the exploration of outer space by A.I. other than humans.

7.2 Definitions

At the beginning of consideration about robot autonomy in outer space, it is crucial to define both "robot" and "autonomy." These terms are not well defined in any law concept although some attempts to do so have already been made.[3] From the technical point of view, robot is something between the simple machine and an artificial human being. It was designed for a purpose, is able to sense the environment, and moves itself or its parts.

Defining autonomous robots is much more difficult. It is said that an autonomous robot differs from a remotely controlled one in time that it can operate by itself. There is not such a case of fully remote-controlled machines and quite a long time in case of robots with high levels of autonomy. Autonomous robots could be additionally self-learning and adopt their behavior to the changes in the environment they are operating. They are at least periodically able to perform their tasks and make decisions without any control of any human operator.

As the autonomy of robots develops, robots are able to perform more difficult and responsible tasks and elongate the period during which they do not depend on human decisions. This is the reason why some rules of their behavior had to been defined.

7.3 Principles[4] for Autonomy of Machines

There are a lot of people who proposed some kinds of rules that robots or their creators should follow. A majority of them were science fiction writers or fans, computer scientists, or roboticians. They were the ones that realized that this issue started to be important. Lawyers became interested in this topic only a couple of years ago.

The first set of rules was given in 1942 by Isaac Asimov in his story "Runaround." They become popular and known also for people who did not know his stories. They

[3] South Korea and the European Union have already started working to develop robot and AI law.

[4] In fact the described principles are called laws. The author called them principles to avoid misunderstanding – they are not a part of any statutory law.

have never become statutory law, but they are a set of universal principles that a lot of people follow in their understanding of robotic law. The Three Laws are[5]:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First and Second Law.

These were accompanied later with the zeroth law[6]:

0. A robot may not injure humanity or, by inaction, allow humanity to come to harm.

The last (or the first in the sense of their order) law might be especially valuable for robots operating in outer space as it leaves an open door for situations when any other life form would be found at any celestial body.

The Three Laws were the only robotic laws for a long time, but in the 1990s Mark W. Tilden set up a new set of rules for robots based on the Darwinian model. He pointed out that robots are similar to biological creatures, and thus the most important for them should be to protect themselves, to feed themselves, and to find their property. It leads to a set of rules that express nature rules in electronic environment[7]:

1. A robot must protect its existence at all costs.
2. A robot must obtain and maintain access to its own power source.
3. A robot must continually search for better power sources.

These two concepts are strictly opposite: from the robot as a slave of a human being we went to a robot that is a separate independent being. The first idea concentrates on human security which is in line with current ethics. Human life has the highest value and thus should be protected no matter what the circumstances are. The second idea does not take any human being into consideration. According to Tilden's laws, robots are another group of creatures beside humans, animals, and plants, so they should behave like humans, animals, and plants. They should make use of the available resources taking into account only their own security.

There is also a third important set of principles for robotic designers, builders, and users. They were developed by researchers with different backgrounds: engineers, physicists, sociologists, and ethicists from both the Engineering and Physical Sciences Research Council (EPSRC) and the Arts and Humanities Research Council

[5] Isaac Asimov, "I, Robot," 1950.

[6] Introduced by Isaac Asimov in his novel *Robots and Empire*. Usually called the zeroth law as is should precede Three Laws because it is the most important and the most general one. Sometimes called Fourth Law as it was created after Three Laws.

[7] Presented in 1994 during Fred Hapgood interview with Mark W. Tilden for Wired magazine. https://www.wired.com/1994/09/tilden/?pg=1&topic=

(AHRC) of Great Britain. They pay attention to the purpose for which the robots are designed and the ethics robots should follow. The EPSRC/AHRC principles are[8]:

1. Robots should not be designed solely or primarily to kill or harm humans.
2. Humans, not robots, are responsible agents. Robots are tools designed to achieve human goals.
3. Robots should be designed in ways that assure their safety and security.
4. Robots are artifacts; they should not be designed to exploit vulnerable users by evoking an emotional response or dependency. It should always be possible to tell a robot from a human.
5. It should always be possible to find out who is legally responsible for a robot.

The above concept lays somewhere in between Asimov's and Tilden's laws. Human life and security are the most important, but robot safety and security should also been taken into consideration. The influence of Asimov's hierarchy between humans and robot is significant, but there are not only the rights of humans that are assigned. Also the responsibilities are strictly defined. Humans are liable for robot behavior and their consequences. Humans are the ones that should ensure robots with a safe environment and protect them. The relations between humans and robots are similar to minors and their parents or guardians in statutory law.

7.4 Liability

All the above laws are rather general principles to follow to put the autonomy concept in the right direction. They are not officially created or at least accepted by any legislators. However they describe to some extent the rights and obligations of robots and their creators. They could have an impact on the statutory law, especially in the case of EPSRC/AHRC principles, which touch the issues of social law.

South Korea was the first state that tried to develop a set of statutory laws on robots and their existence. They were meant to be preceded by the South Korean Robot Ethics Charter.

The European Union also sees the need for a legislative motion for robots. The Policy Department of the European Parliament drafted the key issues[9] that should be covered. A majority of them will be important also in outer space. The first and the most important issue is to create an international register of robots and make a possibility to identify any single robot and to put its data into the register. It would allow to clearly identify the owner[10] of the robot who is responsible for it. All

[8] The laws were published in 2011 by the Engineering and Physical Sciences Research Council (EPSRC) and the Arts and Humanities Research Council (AHRC) of Great Britain.

[9] Nathalie Nevejans, "European Civil Law Rules in Robotics," Directorate-General for Internal Policies, Policy Department C: Citizens' Rights and Constitutional Affairs, 2016.

[10] Only if a relation of the ownership will remain between people and robots. It might be converted into tutor, creator, or even an employer if robots obtain any kind of legal personality.

producers should be forced to develop a built-in kill switch that allows to turn off a robot in case of its improper behavior and leaves a possibility to update its software if necessary. In other words, the idea is to identify a person or an organization responsible for any robot either as an owner, a producer, or a user and to attach to them the appropriate level of liability. The robots' liability is then in fact the liability for the robots, and it should work both on Earth and in outer space.

The situation was further complicated this year when the first robot was given a citizenship. It happed in Hasselt, Belgium. Fran Pepper was given Belgian citizenship, and thus she is also a citizen of the EU. Her parents are Astrid Hannes and Francis Vos. The question arises if they are liable for Fran. Or maybe she is liable for herself? Can a human be liable for a robot who has a citizenship?[11]

There is a concept to give robots a digital personality which makes them liable for themselves. They would then be able to be accused and be sentenced. It is predicted to be working for robots with a high level of autonomy. But then the high level of autonomy should be defined. Suppose we have a robot with great autonomy and thus with a digital personality. Is the robot liable for himself just from the beginning of its existence? Is he first in his childhood (training period)? Where is the border between being a child robot and an adult robot?

Nowadays humans are robots' producers. Thus the issue of being responsible for a robot touches only human. In the near future, it might be possible that a robot will develop another robot. The question arises about the human owner or producer of a robot. Will it be an owner/producer of an original robot (inheritance concept)[12] or an owner of a place or resources where the creations were done (nationality concept).[13]

7.5 Space Law vs. Robotic Law

The concept of robotic and AI law is quite new, and thus it is not present yet in the law concepts of every nation. Some nations consider giving "personhood" status to robots, while others are not taking any considerations on the matter. It might lead to unequal treatment of robots and their liability if the "electronic personality" of robots will not be a common concept defined by the worldwide space law. There is a lot to do in that matter, but it is crucial to develop an ontology that contains words common for robotics and the space sector.

The size of outer space is enormous, completely incomparable with the number of robots that has been there. One may say that it is rarely probable that a robot will meet another robot or human in space, and thus it is even less probable that a robot could create harm to somebody or something. But the law should be prepared for

[11] http://www.bankier.pl/wiadomosc/Robot-zostal-obywatelem-Belgii-Dostal-oficjalny-akt-urodzenia-7497128.html

[12] The owner of a robot is also an owner of all robots produced by his robot.

[13] The owner of any resources (parts, production lines) that were used to produce robots becomes an owner of a created robot.

that. The liability issues have to be defined. They are quite well defined in Article VI of the Outer Space Treaty (OST) that says: "States Parties of the Treaty shall bear international responsibility for national activities in the outer space."[14] A more detailed liability can be defined at the national level of every state that signed the Outer Space Treaty. The correlation between international law and national law is well stated. This is the nationality that should be specified for every robot. It could be secured by a new article saying that each robot launched into outer space or produced there has to be clearly identified with a particular state party.

7.6 Conclusions

The Outer Space Treaty should be redirected by adding appropriate sections of robotic law. As it will be a treaty for different nations with different levels of their digital development, it should have simple rules to follow by robots on different levels of complexity. There is a lot to do, and the recommendations are given below in a form of an algorithm:

1. Define "robot" and "autonomy."
2. Differentiate between a robot as a thing (object or machine) and a robot as a being with legal personality.
   (a) If a robot is an object, check if the current rules of the OST hold (especially Articles VII and VIII).
   (b) If a robot is a legal person, create set of rules that this being could follow (rewrite especially Article V).
3. Go through the OST, and check what actions (i.e., exploration) are predicted to be for humans or could be done by robots. Add robots in appropriate articles.
4. Revise Article XII on the property of one nation available for others in terms of robots as both users of the property and an element of the property.
5. Check if the treaty is in line with the current state-of-the-art robotic ethics.

The attention should be paid on the speed in which the robotics changes. The Outer Space Treaty has remained unchanged for 50 years. It might happen that after some changes, it will need some updates in a couple of years. It is sure that changes in robotics will be done and that they will be done very fast, but there is nothing sure about the conditions for beings after the changes. Thus it is not possible to predict what rules the Outer Space Treaty will be needed in the next 50 years. Any changes should express changes that are now or will be in a few years. Nowadays humans try to put robots into humans' law, give them humans' work and responsibilities, and assure themselves from any harm that could be done to them by robots. It is possible

[14] Article VI of the Outer Space Treaty defines liability for exploration of space. Every space party is responsible for any action undertaken by its citizens or companies in space.

that robots will not be interested in cooperation with humans at all[15] and they will create their own laws.

Thinking about physical robots, it is also worthwhile to consider an autonomous agent which[16] is not a robot according to the definition mentioned in this article. In might happen that, as our reality becomes more virtual, an autonomous piece of software will take over the goals of a physical robot. It will be able to make an effect on humans similar to the one that the robots would make or even greater. It will have great possibilities and responsibilities but it will not move physically any of its parts.

The Outer Space Treaty after 50 years is still a perfect background stating rules for exploration of outer space. However, some new laws should be added to specify the use of robotics and artificial autonomous beings.

[15] Eliezer S. Yudkowsky, Artificial Intelligence as a Positive and Negative Factor in Global Risk, 2007, http://yudkowsky.net (Access in July 2017).

[16] Maybe there should be *who* instead of *which* if robots obtain digital personality as proposed in the merit to European Commission.

Chapter 8
Into the Twenty-First Century: Integration of Principles of Global Governance in Space Law

Valentin Degrange

Abstract This analysis aims at proposing a fresh legal view of the Outer Space Treaty (OST) that would conciliate the presence of both nations and private entities in the industry. The latter, who has been revealed to be a major player of the space industry in the last two decades, is today slowed down by the absence of clear international legislation in several domains pertaining to the exploitation of outer space. In order to allow for the growth of the space sector, it then seems essential for the international community to act accordingly. On the 50th anniversary of the Outer Space Treaty, it is fitting to envisage a substitute that would need to take into account the commercial aspirations of states but also protect the ability of firms to generate profit in order to foster investments. This could be accomplished by integrating principles of global governance to international space law in order to dynamize the sector, all the while setting up a regime that affirms the status of states as patrons of the protection of the general principles of the original OST. This way a balance could be found between the ambitions of the private sector and the sovereignty of nations.

8.1 Introduction

While we are already well into the twenty-first century, it appears clearer now that new actors are progressively becoming the leaders of the space industry to the detriment of states. Nations have been the primary subjects of international space law ever since the Outer Space Treaty of 1967 and are still for a large part responsible for the production of norms pertaining to space activities, but the private sector is becoming increasingly important to the survival and development of the industry. Private actors are indeed not only a major source of financing but also the instigators of space projects on a grand scale, and their expansion in the space sector is steadily ousting nations as the number one space actors.

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A. Froehlich (ed.), *A Fresh View on the Outer Space Treaty*, Studies in Space Policy 13, https://doi.org/10.1007/978-3-319-70434-0_8

This tendency is not a particularity of the space industry but only a mere facet of a global phenomenon of denationalization of international law.[1] It seems it should be time for the international community to react accordingly and to adapt space law to the challenges it faces today. The main issue is that while the OST implemented a number of general principles with the intent of regulating a space race between opposing superpowers, it left out many important details on the account of there not being sufficient technology to fully exploit outer space at the time. As a result, vague definitions and divergence of interpretations[2] have led most private actors to hold back on their projects, fearful that there would be unforeseen consequences to their space activities. These divergences, ranging from the definitions of "space object" or "mankind" to the many interpretations of the non-appropriation principle or the delimitation of outer space, have made investors wary of the potential fallout of their businesses. For example, the actual effervescence about the exploitation of natural resources of outer space, and the relative failure of the Moon Agreement of 1979, have proven the necessity to calm the fears of the private sector concerning the "equitable sharing by all State parties in the benefits derived from those resources."[3]

This has unfortunately slowed down the development of space activities since the beginning of the twenty-first century and condemned private entities to a standstill while nations are still arguing over the interpretations of the articles of a treaty concluded 50 years ago. A possible solution to this legal deadlock between states would be to try and conciliate the presence of both nations and private actors in the industry. This would mean taking into account the commercial aspirations of states on the one hand and protecting the ability of firms to generate profit in order to foster investments on the other hand. Such a goal could be accomplished by integrating principles of global governance[4] to international space law and allowing bottom-up

[1] Christian Chavagneux, "La montée en puissance des acteurs non étatiques," in Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), *Gouvernance mondiale* (Rapport du conseil d'Analyse économique n°37, La documentation française, 2010) 233; Lider Bal, *Le mythe de la souveraineté en Droit international, La souveraineté des États à l'épreuve des mutations de l'ordre juridique international* (Thesis, Centre d'études internationales et européennes, Université de Strasbourg, 2012).

[2] Brendan Cohen and Elena Carpanelli, "Interpreting 'Damage Caused by Space Objects' under the Liability Convention" (2013), 56, 56th IISL Colloquium on the Law of Outer Space, Proceedings of the International Institute of Space Law; E. Fasan, "The meaning of the term mankind in space legal language" (1974), *Journal of Space Law*, 125; Fabio Tronchetti, "The non-appropriation principle under attack: using article II of the Outer Space Treaty in its defense" (2007), 50, 50th IISL Colloquium on the Law of Outer Space, Proceedings of the International Institute of Space Law; Frans Von Der DUNK, "Liability vs. Responsibility in Space Law: Misconception or Misconstruction" (1991), Space and Telecommunication Law Program Faculty Publications; Olavo de O. Bittencourt NETO, "The elusive frontier: revisiting the delimitation of Outer Space" (2012), 55, 55th IISL Colloquium on the Law of Outer Space, Proceedings of the International Institute of Space Law; S. Gorove, "Interpreting article II of the outer space treaty" (1969), Fordham Law Review, 351; S. M. Williams, "The principle of non-appropriation" (1970), 13, IISL, 157.

[3] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 18 December 1979 (entered into force 11 July 1984), art. 11§7d.

[4] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), *Gouvernance mondiale* (Rapport du conseil d'Analyse économique n°37, La documentation française, 507 p., 2010).

international lawmaking[5] to become an effective way of producing space law, all the while setting up a regime designed to temper the influence of private actors in order to keep the general principles of the original OST from being violated.

8.2 Governance in Outer Space: An Instrument of Development

In order to make international space law a more comprehensive set of rules, lawmakers would have to take into account the needs of the industry and its actors in a dynamic sector and not only national interests of states that invariably end up slowing down or even blocking its development. To do so, this analysis proposes to integrate principles of governance to space law as well as to establish an institutional framework adapted to the specificities of space activities.

Governance is a controversial notion because it is defined in a variety of ways, sometimes contradictory, but also used in a variety of fields (public, private, environmental, corporate, global, etc.). For the purpose of this discussion, it will be defined as the establishment of policies, and continuous monitoring of their proper implementation, by the members of the governing body of an organization. It includes the mechanisms required to balance the powers of these members, with the associated accountability, and to enhance the prosperity and viability of the organization through efficiency. According to Stoker,[6] governance implies five essential elements: the intervention of many actors, which do not all belong to the governmental sphere; an erasure of frontiers between public and private sectors; an interdependency between the institutions associated with collective action; there are networks of autonomous actors; and finally, a possibility of acting without relying on state power or authority. In the present case, we will focus on global governance, which can be defined as "the complex of formal and informal institutions, mechanisms, relationships, and processes between and among states, markets, citizens and organizations, both inter- and non-governmental, through which collective interests on the global plane are articulated, right and obligations are established, and differences are mediated."[7] Rosenau has used the term "global governance" to denote the regulation of interdependent relations in the absence of an overarching political authority.[8]

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[5] Janet K. Levit, "Bottom-Up International Lawmaking: Reflections on the New Haven School of International Law" (2007), 32, Yale J. Int'l L.

[6] Gerry Stoker, "Cinq propositions pour une théorie de la gouvernance" (1998), revue internationale des sciences sociales, 20.

[7] *Ramesh Thakur; Luk Van Langenhove.* "Enhancing Global Governance through Regional Integration" *(2006), 12, Global Governance, 233*.

[8] James N. Rosenau, "Toward an Ontology for Global Governance," in Martin Hewson and Thomas Sinclair, eds., *Approaches to Global Governance Theory* (SUNY Press, Albany, 1999).

In the field of space activities, that last statement is particularly accurate considering that space law is a part of international law in which the primary subjects are states. In regard to the principle of sovereignty, proclaimed in the UN Charter,[9] and to Article I of the OST[10] which states that the freedom of exploration and uses of outer space only benefit nations, the absence of an overarching political authority competent with all space-related matters is especially noteworthy. International space law, up until now, has been laboriously produced through lengthy negotiations between sovereign states defending national interests. Thus, it only encompasses general principles and grand declarations of intention which, while setting up major tenets of this particular field of activity, only grazed the surface and never offered an in-depth international regime addressing the specifics of space activities. Even worse, the lack of a centralized means of law-making or even of a way of coordinating national legal efforts to regulate all aspects of space activities, or at least of harmonizing existing laws, seems to have provoked a sort of regulatory competition between states.[11] In order to attract investments and to encourage private firms to base themselves within their borders, nations now adapt their legislation regarding, for example, the authorization of space activities as well as liability and insurance requirements. The additional observation made concerning the increasing implication of private entities, and the subsequent multiplication of actors involved in space activities, proves the necessity of the establishment of an effective way of regulation.

8.2.1 Classical Models of Global Governance

Concerning the models that could be used to set up an institutionalized space governance, there are several possibilities that need to be addressed here, possibilities that can be sorted out in two different kinds of models: classical models and emerging models. These models are directly inspired from those of global governance,[12] considering the nature of space activities. In order to offer an exhaustive analysis of these institutional shapes, it is imperative to start with the two classical forms of global governance even though they don't offer an operational model in today's economy. The first of these two classical models is that of the world government[13] which is basically the transposition on a global scale of a federal government. It

[9] Charter of the United Nations, 26 June 1945 (entered into force 24 October 1945), art. 2§1.

[10] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967 (entered into force on 10 October 1967), art. I.

[11] Dimitri Linden, "The impact of national space legislation on private space undertakings: a regulatory competition between States?" (2015), vol. 58, 58th IISL Colloquium on the Law of Outer Space, Proceedings of the International Institute of Space Law.

[12] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 66.

[13] Idem.

would then use a single unified set of rules under the supervision of a global parliament. There are many advantages such a model could procure to the world and to the space industry in particular – a unique set of rules for all private actors of the world, space programs run by the global government, etc. – and it has sparked many brilliant ideas from researchers all over the world (e.g., the Tobin Tax,[14] the cosmopolitan democracy of Held,[15] or the global federalism of Dani Rodrik[16]). It is however very unlikely that we will ever see that kind of model in action. The mere example of the European Union shows the difficulty to unify different countries under one federal government. Furthermore, it seems unnecessary to go to such length only to make the space industry more efficient.

The second classical model of governance that needs to be presented here is that of institutionalized cooperation of nations.[17] Contrary to the world government which is largely of a hypothetical nature, this one is on the contrary quite operational as it is the one that has been used ever since the end of the Second World War. According to this neorealistic approach, states are the sole source of legitimacy and organize themselves to cooperate according to their needs. This cooperation can be somewhat limited (e.g., League of Nations) or more demanding (e.g., United Nations) but is of an intergovernmental nature in any case. In effect, it is more or less the model that has been used in space-related matters since the first Space Race. Nations are asked to cooperate, either through the system of the UN or all five space treaties, but the level of cooperation between states is still relatively low. Space powers generally prefer to conduct their own activities and confine situations of cooperation to specific operations, as it is the case with the International Space Station, for example.[18] While it seemed like the best model to use for a long time, the institutionalized cooperation of nations does have limits that prevent it from being an effective way to govern space activities in today's world. The strength of this model lies in the fact that it should combine the effectiveness of proven solutions with the legitimacy enjoyed by democratic governments. However, it is unsatisfactory on both accounts because when national interests differ, intergovernmentalism transforms every issue into a bargaining object, resulting in the formation of coalitions and the elaboration of compromises whose efficiency is questionable at best. In conclusion, this model of governance, while respecting principles of sovereignty and making nations the sole originators of laws, also slows down the development of the space industry in

[14] James Tobin, "A Proposal for International Monetary Reform" (1978), *Eastern Economic Journal*, 153.

[15] Daniele Archibugi and David Held (eds.), *Cosmopolitan Democracy. An Agenda for a New World Order* (Polity Press, Cambridge, 1995); David Held, *Democracy and the Global Order* (Polity Press, Cambridge, 1995).

[16] Dani Rodrik, "How far will international economic integration go?" (2000), vol. 14 n°1, *Journal of Economic Perspectives*, 177–186.

[17] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 68.

[18] International Space Station Intergovernmental Agreement, 29 January 1998 (entered into force 27 March 2001).

that every step forward becomes incredibly difficult especially since it is already worth over US$330 billion[19] and generates hundreds of thousands of jobs.

The classical models of global governance seem to be rather ineffective at being applied to space activities and already don't correspond to the reality of contemporary economy, but it is however conceivable that the emerging models of governance that recently sprung up in international law could. The classical models are based on the assumption that legitimacy is derived from elections, while in fact most specialized institutions (both national and international) do not humor democratic requirements. Experts are appointed, not elected, in order to bring a certain competence to the table and to make decisions based on efficiency. The models of governance that have been emerging in the international society for the past few years clearly stand on that side of the line and will be presented here as potential solutions for a governance of space activities.

8.2.2 Emerging Models of Global Governance

The first of these models is that of the network of independent authorities,[20] which is the most representative of these emerging models. The literal or figurative "shareholders" of these authorities are the states. Therefore, their legitimacy is ultimately based on the democratic process that has established their missions and the method of appointing their officials and specified their obligations of transparency and the conditions under which they are to report on the execution of their mandate, but their distance from politics is an asset rather than a handicap. Tirole[21] reckons that delegation to an independent body is preferable to political responsibility, for example, when decisions are too technical for voters to exercise direct control over the elected officials, when consequences are only known with great delay, or when the preferences of the majority can be severely harmful to a minority. This model has a certain relevance in terms of global governance and even more so concerning space activities where institutions of experts could be given authority to legislate on space matters.

The second model that is used in international law and which could be used to set up a space governance is the model of Law without the States.[22] It is based on the action of supranational judicial bodies, and its central argument is that on the basis of a legal corpus (which can be very limited), the dynamics of jurisprudence are

[19] As shown in the 2015 Space Report of the Space Foundation, URL: https://www.spacefoundation.org/sites/default/files/downloads/The_Space_Report_2015_Overview_TOC_Exhibits.pdf

[20] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 70.

[21] Jean Tirole, "La gouvernance des institutions internationales," in Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), *Gouvernance mondiale* (Rapport du conseil d'Analyse économique n°37, La documentation française, 2010) 291.

[22] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 71.

likely to produce an efficient legal system.[23] This model builds on both the movement of private international law production at the initiative of enterprises and the intensification of production of public international law following the establishment of the World Trade Organization's (WTO) Dispute Settlement Body (DSB). The first movement, through the combination of private and public initiatives, led to the emergence of a "law of globalization" with an economic vocation. The second is sufficiently striking for having given rise to the disputes that we know. In both cases it is no longer possible to ignore the fact that new sources of law have emerged, beyond the usual procedure of international negotiation between governments. In the specific context of space law, it can be noted that no international jurisdiction except the International Court of Justice (ICJ) is competent to sit in judgment for space-related litigation. The creation of a specialized supranational judicial body, however, could be a sufficiently flexible method of creating standards to accommodate the evolutions of space technologies and activities. It might not only be the occasion to put specialized judges up to the task but also to allow non-state parties, such as private firms, to make their cases before the court. In any case, the creation of such a judicial body might become necessary considering that with the increase in space activities, the number of disputes will almost certainly escalate as well and the ICJ is not equipped to deal with a potentially huge number of cases.

Finally, the last emerging model of global governance that could be used to foster the development of the space industry is that of private autoregulation.[24] It would indeed be foolish to limit the scope of alternatives to public regulations. In their absence, private regulations soon take root, occupy space, create norms, and establish jurisprudence. This is eloquently illustrated by the case of the Internet, where, despite its weaknesses (weak legitimacy, uncertain authority, institutional complexity, jurisdictional conflicts, legal uncertainty, lack of sanctioning power), the Internet Corporation for Assigned Names and Numbers (ICANN) and other private regulators have, thanks to their speed and flexibility, decisive advantages over public regulation and essentially determine the rules of the game. Furthermore, the modalities of private regulation can be sources of inspiration for public regulation. To overcome the shortcomings of traditional public regulation, Rischard has recently proposed the creation of Global Issues Networks,[25] which involve governments, civil society, companies, and international organizations, on a number of international issues. The objective would be to produce recommendations or noncoercive codes of conduct. Rather than waiting for the implementation of general obligations and associated compliance mechanisms, Rischard proposes to rely on soft law tools and on reputation effects to ensure their effectiveness. Regarding the space industry, this model could present the undeniable advantage of putting the responsibility of regulating space activities in the hands of those directly involved: professionals and

[23] Marie-Anne Frison-Roche, "Le droit, source et forme de régulation mondiale," in Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), *Gouvernance mondiale* (Rapport du conseil d'Analyse économique n°37, La documentation française, 2010) 313.

[24] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 72.

[25] Jean-François Rischard, *High Noon: 20 Global Problems, 20 Years to Solve Them* (Basic Books, 256 p., 2003).

industrials. This form of bottom-up lawmaking[26] would not only allow for the growth of the space sector but would also be able to cope with its rapid evolution, contrary to public instances.

In conclusion, it seems that there are a number of options at the disposal of the international society in order to not only regulate space activities more efficiently but also to enable the law to keep up with their constant development. Any of these models could be implemented by a treaty and then used to apply principles of good governance to the space sector. However, it should be kept in mind that the OST has proclaimed general principles of great moral value and that those principles should be protected by a regime that takes into account not only the needs of the industry but those of all nations as well. Thus, it would seem imperative for the international community to take both into account if it were to ever amend the Outer Space Treaty or to conclude a new one.

8.3 The Necessity to Mitigate the Influence of the Private Sector

Indeed, though it may seem desirable to include private actors in the lawmaking process (either through specialized institutions, judicial precedent, or private regulation) in order to make the industry more competitive and foster its development, precautions must however be taken in order to avoid a tyranny of the market. Unbridled private space activities could go against all the principles that were proclaimed in the OST to protect outer space as a *res communis* as well as the rights of all nations of the world. The idea is then for the international community to build a regime that stimulate the growth of the space industry by making laws that fill in the blanks left by the OST and by offering satisfying interpretations of obscure points of regulations, all the while conciliating with the intention of the general principles proclaimed by the treaty.

The most relevant example would be that of the non-appropriation principle,[27] especially considering the interest recently expressed by numerous private firms to exploit the natural resources of outer space.[28] If the 1967 Treaty prohibits the national appropriation of outer space, the Moon and other celestial bodies, it does not explicitly forbid other forms of appropriation. Over the years, several interpretations of Article II of the OST have been made. Some people think that individual ownership by a private company or an international organization is therefore possible, since it

[26] Janet K. Levit (n 6).

[27] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967 (entered into force 10 October 1967), art. II.

[28] Several examples can be given here, such as Planetary Resources (URL: www.planetaryresources.com) or Deep Space Industries (URL: http://deepspaceindustries.com/).

is only a question of national appropriation.[29] Others believe, on the contrary, that the principle of non-appropriation is absolute and prohibits not only the creation of public rights but also private rights, first because Articles VI and VII cover both governmental and nongovernmental activities and second because the preparatory work of the 1967 Treaty shows that the drafters' will was "to totally prohibit national appropriation."[30] Finally, a third, more nuanced interpretation indicates that there is a flagrant but not intractable contradiction between the idea of freedom of use and that of non-appropriation. The installation of bases, factories, airstrip laboratories, etc. on a celestial body will create de facto exclusive rights of use on the corresponding plots of land. The possibility for entities to lease or sell the facilities that it has built will give rise to the legal title "real estate" and not "land" and therefore respecting the principle of non-appropriation. We can therefore envisage private rights relating to the use of body and of this space.[31] The fact is that the lack of action from the international community concerning the interpretation of Article I has led private actors to hold back any project of exploitation of natural resources, which only changed recently with the recent adoption of the "Space Act" in the USA.[32]

8.3.1 Globalist Interpretation

Article I of the OST[33] claims that space activities "shall be carried out for the benefit and in the interests of all countries," which raises the question of whether profits derived from commercial use of space by a private enterprise should be shared among all members of the international community. There are two answers to that question. First, the globalist interpretation tends to say that the commercial use of space must ensure a profit for all mankind. This does not necessarily mean the activity itself but essentially the end result of the enterprise. Marcoff argues "… the final results of any excavation, transformation, or trade, of the non-renewable natural resources of the celestial bodies, must be 'de lege lata' for the benefit of all States, irrespective of their stage of development."[34] We can assume that the same could be said about any form of commercial space activity. The main argument here is that redistribution of profits is perfectly consistent with and follows logically Article I of the 1967 Treaty. Nothing, therefore, prohibits the lucrative private commercial activity as long as the benefits derived therefrom are universalized either by being redistributed or by serving the common interest of all countries. For this reason, this

[29] S. Gorove (n 3), 351.

[30] S. M. Williams (n 3), 157.

[31] Mireille Couston, *Droit Spatial* (Ellipses edition, Paris, 2014), 71.

[32] *H.R.2262 – 114th Congress (2015–2016): US Commercial Space Launch Competitiveness Act*.

[33] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967 (entered into force 10 October 1967), art. I.

[34] M.G. Marcoff, *Traité de DIPE* (Fribourg, 1973, 678).

interpretation is the most popular among developing countries. This theory, however, is questionable for several reasons. First of all, it can be considered "unnatural" in regard to commercial motivation. Second, it is contrary to the general principle of equity of international law, since only a few countries would then contribute to the development of space activities, while the benefits are redistributed to all. And finally, the question of losses is totally ignored, to speak only of the benefits, whereas it would be logical in a scheme of universal collectivization to share the two. One could, however, imagine an equitable and proportional distribution of the efforts made for the development of these activities in order to reconcile principles of common interest and private interest.

8.3.2 Restrictive Interpretation

The second interpretation is the restrictive interpretation, according to which Article I of the 1967 Treaty is interpreted as a mere declaration of principle expressing a wish.[35] This principle would therefore not be self-executing. Only outer space and celestial bodies, or scientific information derived from their exploration, should be used for the benefit of all, the economic results of their use normally belonging to the state/group of states/private firm that acquires them. That is the most reasonable interpretation, if only because it preserves the interest of the private sector, driven by the search for profit, to actually invest in the space industry. More subtle solutions must then be found to promote the equal exploitation of space, depending on the situation and the type of exploitation envisaged: institutionalized sharing of technologies, establishment of concessions for mining activities, etc. At first glance, the idea of making private companies an official actor in space activities and especially in normative production, through the implementation of an adapted model of governance, does not necessarily give advantages to a particular state or group of states. Yet, the fact is that the majority of these firms are of the nationality of the main space powers, and this would inevitably affect the market and the place of developing countries in space activities. However, it can be imagined that this situation could be tempered by market forces, as it has been the case with the International Telecommunications Union (ITU) and the practice of "paper satellites."[36] The idea of an international regime akin to the OST of 1967 but that would include principles of governance to stimulate space activities is promising, as long as the ambitions of private actors are tempered with skill. This begs the question of the finality of governance.

[35] S. Gorove, "Interpretations of international space law for private enterprise" (1982), ADAS, 319.

[36] which constitute a form of speculation on spectral resources, since they are not associated with real projects but correspond to the acquisition of frequencies for their market value. See Laurence Ravillon, *Droit des activités spatiales – Adaptation aux phénomènes de commercialisation et de privatisation* (Travaux du Credimi, vol. 22, Paris, Litec, 2004), 223.

If the international community ever decides to integrate principles of global governance to the space industry, the former should first of all decide toward which goal the latter must tend. To that regard, two conceptions of global governance coexist. For the first of these conceptions,[37] it must essentially be based on stable rules of the game, the function of which is to coordinate the actions of states and those of economic agents. Its ideal is to be sufficiently clear and universal so that it doesn't need an interpretation or to be supplemented with an executive body capable of discretionary actions (e.g., commercial treaties). In the same way, it is possible to design rules favoring automatic adjustments of flux (of persons, funds, etc.). In this perspective, which can be compared to the German conception of Ordnungspolitik,[38] governance is essentially based on a predominantly economic legal order. States agree to establish a few rules of good conduct, without sharing other values or sharing other purposes. The fact that a partner would disrespect moral principles (e.g., oppressing minorities, destroying the environment, etc.) is ultimately indifferent, as it does not remove or add anything to the advantage of the partnership on a strictly economic point of view. It is only in the case of tortious behavior (e.g., hindering competition, financial instability, identified market failure, depletion of natural resources) that it is necessary to intervene. It shares many similarities with the Law without States model presented above. While this approach could be applicable to the space sector despite its specific aspects, it should however be noted again that space law contains many general principles of a moral nature of which the violation would certainly be detrimental to developing countries and generally all nations that are not space powers, as noted above.

The second conception, global executive body/bodies,[39] presupposes the existence of common goals, whether economic (e.g., growth, full employment, expansion of trade, monetary stability) or not (e.g., peacekeeping, protection of the environment). The finality of governance is therefore defined on the basis of goals that nations set themselves to achieve together, which may have been previously fixed or derived from the consequences induced by their interdependence. The method used to achieve these objectives can be based on the same techniques as in the previous case, but the purpose and basis of governance are not the same. In particular, the idea of the role multilateral organizations should fill differs greatly from that of Ordnungspolitik. They are rather the components of a joint executive body dedicated to the predefined common goals, giving them an irreducible political nature which was absent in the first conception. This approach obviously has a basis in the existence of global issues calling for collective action, but it can also respond to a political logic. This conception of governance would seem to be easily adapted to space activities, considering the highly political nature of the OST, and could be

[37] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 64–65.

[38] Ordnungspolitik/Ordoliberal theory holds that the state must create a proper legal environment for the economy and maintain a healthy level of competition (rather than just "exchange") through measures that adhere to market principles. Patricia Commun, *L'ordolibéralisme allemand: Aux sources de l'économie sociale de marché* (CIRAC, 2003, 272 p.).

[39] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 65–66.

based on common goals of space exploration, utilization, and exploitation. An executive body (or multiple specialized executive bodies), whose staff would be composed of experts and private actors appointed with the benediction of states, would allow for both the production of adapted laws and the protection of all nations' interests. Furthermore, even if Ordnungspolitik has the advantage of giving a lot of freedom to economic actors of the space sector, it is based on a defined set of rules. While those rules could be drafted with the help of private actors, they could however follow to the development of the industry and technologies only with difficulty and constant amendment of the original treaty. On the contrary, an executive body would prove much more adaptable to the evolution of space activities.

8.4 Conclusion

In conclusion, even though the idea of a comprehensive set of economic rules governing space activities would certainly allow them to foster their development, the creation of rules of both an economic and general nature in conjunction with that of specialized bodies – whether they be of an executive or judicial nature – would be much more efficient at maintaining a balance between the needs of private actors and nations. A new take on the OST should therefore not abandon any of the rules it has set up 50 years ago but on the contrary add new ones taking into account the new commercial uses of outer space and implement structures capable of enforcing them. Obviously, none of the models of governance presented above provide the basis for a comprehensive scheme around which to organize the governance of space activities. This calls for the construction of an original and sustainable model made by borrowing from these different categories, in order to set up a hybrid governance[40] of the space sector. Such a model could be made up of a network of independent authorities, each specific to a particular branch of space activities and with their own set of prerogatives. Meanwhile, private actors could produce recommendations or noncoercive codes of conduct rather than wait for the implementation of general obligations and in turn inspire public regulators when their intervention is needed. Finally, all these actors would be subjected to the authority of a specialized international judicial body charged with enforcing space law and settling disputes.

However, in order to guide the elaboration of such a model of governance, a number of principles that respond to general objectives of efficiency, legitimacy, and transparency should be identified. The French Council of Economic Analysis proposes to select six principles: the *specialization* of institutions, so that citizens of the world could, through national and international associations and nongovernmental organizations, exercise a critical role on a clear basis by overseeing the way in which their mandates are fulfilled; *political accountability*, which refers to discussions on the mode of global governance and the nature of institutions; the *bal-*

[40] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 74.

ance between areas of expertise and associated institutions; the *transparency* and *democratization* of procedures which, associated with the specialization of institutions, should guarantee the legitimacy of decisions; *subsidiarity*, that is to say that decisions must be taken at the most decentralized level if the transition to a higher level is not required in order to assure a certain level of efficiency; and finally *solidarity*, in order to mitigate market failures that prevent or delay development, compensate the losers of globalization and/or ensure against the economic hazards it entails, and redistribute wealth to the poorest.[41] The alliance of both the general principles of the OST, on the one hand, and of principles of governance, on the other hand, tempered by the use of those six principles should be enough to meet the objectives set out at the beginning of this analysis. To that end, the 50th anniversary of the Outer Space Treaty is the perfect occasion to reflect on the evolutions the space sector has undergone during the last 50 years and to take the necessary steps to adapting its rules to the twenty-first century.

[41] Jacquet Pierre, Pisani-Ferry Jean, Tubiana Laurence (eds), (n 5), 74–92.